Building and Becoming:

DIY Music Technology in New York and Berlin

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Abstract

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This dissertation addresses the convergence of ethics, labor, aesthetics, cultural citizenship, and the circulation of knowledge among experimental electronic instrument builders in New York City and Berlin. This loosely connected group of musician-inventors engages in what I call "DIY music technology" due to their shared do-it-yourself ethos and their use of emerging and repurposed technologies, which allow for new understandings of musical invention. My ethnography follows a constellation of self-described hackers, "makers," sound and noise artists, circuit benders, avant-garde/experimental musicians, and underground rock bands through these two cities, exploring how they push the limits of what "music" and "instruments" can encompass, while forming local, transnational, and virtual networks based on shared interests in electronics tinkering and independent sound production. This fieldwork is supplemented with inquiries into the construction of "DIY" as a category of invention, labor, and citizenship, through which I trace the term's creative and commercial tensions from the emergence of hobbyism as a form of productive leisure to the prevailing discourse of punk rock to its adoption by the recent Maker Movement.

I argue that the cultivation of the self as a "productive" cultural citizen—which I liken to a state of "permanent prototyping"—is central to my interlocutors' activities, through which sound, self, and instrument are continually remade. I build upon the idea of "technoaesthetics" (Masco 2006) to connect the inner workings of musical machines

with the personal transformations of DIY music technologists as inventors fuse their aural imaginaries with industrial, biological, environmental, and sometimes even magical imagery. Integral to these personal transformations is a challenge to corporate approaches to musical instrument making and selling, though this stance is often strained when commercial success is achieved. Synthesizing interdisciplinary perspectives from ethno/musicology, anthropology, and science and technology studies, I demonstrate that DIY music technologists forge a distinctive sense of self and citizenship that critiques, yet remains a cornerstone of, artistic production and experience in a post-digital "Maker Age."

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Acknowledgments

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Introduction

Becoming a DIY Music Technologist: Tools, Techniques, Concepts, and Critiques

Figure 1. Derek Holzer with his Tonewheels Hurdy-Gurdy
(All photos by the author unless otherwise noted)

July 2013, Friedrichshain, Berlin

"Electronic music is the folk music of our time."
- Derek Holzer

Many years ago, instrument builder and sound artist Derek Holzer was apprenticing as a silversmith when he began his journey of dabbling in electronics. An American, he now lives and works in Berlin's Friedrichshain district, just off of the grand boulevard Karl-Marx-Allee. This neighborhood is bounded in part by the East Side Gallery, a remainder of the Berlin Wall that runs along the Spree River, and is crosscut by this thoroughfare, a showcase of socialist classicist architecture once known as Stalinallee. Between the river and the boulevard lies a concentration of trendy clothing boutiques, bars and restaurants, and unconventional music venues. The city's divided past and its current subcultural magnetism never feel too distant from one another in this neighborhood of Berlin.

From inside his workshop, Holzer tells me how he grew up listening to punk rock, heavy metal, and hardcore music; things might have turned out differently if he had *played guitar and joined a band. Without that aptitude, however, he found himself reevaluating how he could leave a sonic mark on the world. Realizing that he could "separate sound and music"—meaning that the former might not require the trappings of traditional instrumental performance training that he considered necessary for creating music—emboldened him to pursue a career in sound that did not resemble the models of bands he grew up with. Holzer experimented with sound collages and field recordings; he picked up a Casio SK-1 keyboard, a primary entry point for the practice known as "circuit bending," and soon he built an analog synthesizer of his own, influenced by instruments like the Buchla synthesizer. After a brief foray into the digital realm, using software to build "virtual instruments," Holzer came to find "computer music performance lacking" and "alienating." His background in building physical materials lent itself more to a sustained interest in the hands-on construction of experimental instruments. Underground and industrial bands like Einstürzende Neubauten "made Berlin sound cool," so Holzer relocated to the city about a decade ago, in the spirit of adventure. To learn more skills, he took workshops, most notably with British instrument builder Martin Howse. He never moved back, determining that "Europe has better arts funding" and values artists and musicians as "cultural ambassadors" in a way that the United States does not. At present, he squeezes out a stimulating but precarious living, selling custom-built instruments with names like Soundboxes and Tonewheels, participating in artist residency programs, and conducting group workshops, during which he guides participants through the building process of his designs.*

Holzer is not alone. He is part and parcel of what he calls a new "folk culture," one that is "low-tech," "amateur," and "made with peers…in a communal setting." It is "a collective experience, but coded in that experience is the form…imposed on people top-down" through its materials (e.g., integrated circuit chips, circuit boards, resistors). In other words, accessible electronics are enabling people to congregate around inventive music making, but this practice of innovation is still laced with conventions. It is an "ephemeral" practice, as components may become quickly outmoded and designs are made in small batches. Holzer and his peers are comfortable with chance, chaos, possibility, and failure in their sounds. Most of all, he says, this practice is "human technology"—it is about reflecting upon "small details" and "uniqueness," and it is "hands-on, even though it doesn't make economic sense."

In the early twenty-first century, New York City and Berlin are home to a group of musician-inventors who, despite their allegiances to an array of subcultural scenes and technological practices, share a surprisingly coherent set of aesthetic and ethical concerns. In this dissertation, I call this group "DIY music technologists" because they independently construct experimental electronic instruments outside the context of large musical equipment corporations, as well as "extensions" of these instruments into other sound production and reproduction equipment, from effects pedals to educational toys to amplification systems. Some of these experiments resemble existing instruments, while others may not even be recognizable as such. My interlocutors range from amateurs to experts; like Holzer, they often begin as casual hobbyists and then emerge as professional experimental instrument builders, generally learning the basics of analog electronics and perhaps other skills such as woodworking, screenprinting, microcontrollers, and 3D printing along the way. Keeping in mind that Holzer considers himself more of a "sound artist" than a "musician," in this study I explore a broad field of DIY music technology that traverses a number of distinct but often overlapping musical lineages, scenes, and genres: underground rock and punk, avant-garde/experimentalism, Maker-age projects,[1] technology start-up companies, sound and multimedia artists, electronic and computer musicians, and small-scale DIY businesses.

In the following chapters, I map out a network of people, objects, venues, organizations, and sonic practices in New York and Berlin that constitute DIY music technology. Given the remarkably diverse musical concerns and subcultural allegiances of these groups, it is astonishing that people within them can be thought of as forming a unique group unto themselves. Yet among the shared concerns and techniques displayed are an affinity for noise, chance, chaos, and incompleteness; an aesthetic preference for the sounds and acts of repurposing outmoded and discarded materials; and a tendency to use tropes from science and industry as concepts behind their creations. DIY music technologists share a family resemblance of traits rather than a clearly demarcated set of aesthetic lists: Holzer, for instance, does not exhaust all of DIY music technology's

[1] The "Maker Age" is a term in general use by the Maker Movement, to be discussed in

possibilities, even though he displays many of them. Some examples of the practices and aesthetics of DIY music technologists I consider in the pages that follow include "e-waste" workshops, in which participants repurpose discarded electronic materials as art and instruments; work by the inventor Martin Howse, who aestheticizes scientific objects while opening up discourses on the relations between science, art, and magic; circuit bending, a practice in which one alters the circuits of previously existing objects to generate new sounds; and start-up companies like littleBits, who make educational electronic toys that are intended to "gamify" the process of learning technical skills.

Drawing on philosophically-inclined anthropology (e.g., Biehl and Locke 2010; Ingold 2011, 2013), I argue that the act of *building* music technology is a rich, multi-layered process of *becoming*, or the co-constitution of self, sound, and instrument, each of which are constantly in flux throughout the building process as the participant acquires skills, knowledge, and ideas. I suggest, following Tim Ingold, that "making is a correspondence between maker and material" and that it is "tantamount to a process of growth" (2013, xi). Ingold elsewhere takes a "dwelling perspective" about human relationships to structures and design(s) as part and parcel of the "immersion of beings in the currents of the lifeworld" (2011, 10); to borrow language from Ingold, as well as Timothy Morton on "the mesh" (2010) and Hugh Raffles on "flows of becoming" (2012), the path to becoming a DIY music technologist entails enmeshing oneself in a current that generally flows toward self- and community-improvement. Through the continual cultivation of sound and self, participants mold themselves into models of ideal, productive cultural citizens while experimenting with models of sound-producing objects.

Let us further consider this notion of *cultivation* as part of the flow of becoming. As Anand Pandian has written in his study on the cultivation of virtue among South Indian agricultural workers, the term carries multiple meanings: "the developmental horizons that lend individual lives a moral impetus and direction; the practical techniques through which people may engage their own desires, deeds, and habits in the pursuit of a moral life; and the material labor that may transform a world of embodied experience into an environment for both moral and natural growth" (2009, 3).[2] In accounting for this mélange of meanings, Pandian views cultivation as "circling between the material work of the cultivator and the metaphorical imagination of a cultivated heart" (19). He asks how the "remaking of character" plays out as people "come to live as they ought to live" (3). These "oughts" are inscribed in cultural and historical contexts that are far from universal. Charles Hirschkind, for instance, studies the cultivation of virtue through Islamic cassette sermons in Egypt, in which the act of listening to media technology fosters a very different ethos grounded in religious values (2006). I believe that addressing how people come to grapple with (re)making in particular scenarios—just what can or should be made, and how?—can tell us much about the breadth and depth of ethical life for my interlocutors in New York and Berlin.

In framing cultivation as an "ethos," Pandian draws on a line of Western thought that ties it to pedagogy, from Classical Greek and Roman texts to German kindergartens

[2] Pandian's definition of *development* is "the promise of a gradual improvement of life, and the fulfillment of its potential for progressive growth through deliberate endeavors in transformation" (2009, 6). Those who seek this transformation are "subjects of development," or "cultivators" (7). Note also the juxtaposition of "progressive growth" with "circling," implying something more complicated than a teleological progression towards a perfect self. In the vastly different cultural context of my interlocutors, I can say with some certainty that they do not find it fruitful to imagine an end goal for what a perfected self would entail.

to projects imposed on the subjects of colonialism, all in the name of moral education (2009, 19-20). In this project, I explore alternative, informal pedagogies of building that operate under the assumption of an already shared ethos while also reinforcing one. Beyond a smattering of formal university classes imparting applicable skills (in places like Columbia's Computer Music Center and New York University's Interactive Telecommunications Program),[3] I show how DIY music technology is learned through a mix of online resources, how-to books, events, and group workshops. The very act of deciding to build one's own instruments is a protracted choice. No one learns the necessary skills because it is the easy way out; in fact, I have overheard the musing, "DIY? More like 'do it the hard way.'" Participants do it themselves in order to galvanize their imaginations, gain personalized control over sounds and materials, contribute a valued community role, and facilitate the improvement of skill-based knowledge.

Many of DIY music technologists' motivations are rooted in long-standing social and philosophical issues, such as the Western notion of the self and the purpose of art. According to literary scholar Leo Damrosch (2003), a paradox emerged in early modernity that people steadfastly believed they were unique, self-sufficient individuals while simultaneously acknowledging that they were shaped by external social forces. Thought had also shifted during the Enlightenment from the Classical notion of art as serving a moral purpose to exploring the aesthetic as a separate realm (42), presenting challenges as to what one's artistic endeavors could or should entail. Damrosch exemplifies this paradox in the difference between the Enlightenment figures Jean-

[3] For instance, in 2011 I enrolled in a Columbia class on electroacoustics with Douglas Repetto, which involved basic electronics, Arduino microcontrollers, and coding in the Processing platform.

Jacques Rousseau and Benjamin Franklin—the former, an inward-looking, philosophical intellectual; the latter, an action-oriented inventor and social problem-solver. I find that Franklin offers a prototypical American figure embodying the spirit of the Maker strain of DIY music technology (for example, with his invention of the glass harmonica), while these ambitions among my interlocutors are also tempered by a Rousseauian reflection. This push-and-pull of building and reflection results in what has come to be known as "critical making" (see Ratto and Boler 2012, below).

In theorizing acts of designing and making music technology, I develop anthropologist Joseph Masco's concept of "technoaesthetics," or "aesthetics delivered through machines, constituting a specific fusion of appearance and utility" (2006, 38). I complement this definition with attention to *sound* in considering the material, conceptual, and sensory realms of the building process and their "complicated pleasures" (Dunne 2005), in order to connect the inner workings of musical machines with the personal transformations of DIY music technologists, as inventors fuse their aural imaginaries with industrial, biological, and sometimes magical imagery. Design anthropology is another lens through which to explore how we carve out niches of self and skill as "user-producers" in the midst of sociotechnical shifts (e.g., Gunn, Otto, and Smith 2013; Ingold 2011). Throughout this dissertation, I put discourses of design into dialog with the growing theme of critical organology in music scholarship, an approach that reappraises the "social lives" (via Appadurai 1986) of musical instruments (e.g., Bates 2012; Dawe 2001; Sonevytsky 2008; Théberge 1997; Tresch & Dolan 2013). I investigate these and other interdisciplinary approaches that grapple with technology, ethos, and the self, as they relate to musical (re)invention.[4]

Although tinkering with electronics and music technology has a long, detailed history within the last century in the United States and Europe (e.g., Ghazala 2004; Jones-Imhotep 2008; Pinch & Trocco 2002; Waksman 2004; Weidman 2003; among many others), increasing mobility and portability (Katz 2010), open-source and remix-able modes of distribution (Lessig 2004, 2008), and global, experimental listening practices (Novak 2008) have transformed the manner and speed in which projects are conceived, aesthetics are evaluated, and relationships are established. The contemporary push-and-pull of fast-and-slow melds insights as diverse as the back-to-basics of the Slow Food movement and dumpster diving (Simonetti 2012; see also chapter 3) and the dizzying speed of technologies emphasized by Paul Virilio, who writes that our "spatiotemporal perspective" may be "abolished by the acceleration effects of communication technologies" (1995, 36). Design, too, accounts for this paradox, particularly in the vernacular realm:

> Vernacular design, design whose provenance is tied to a particularity of place, material, and mode of production, has served as a 'sacred cow' within design culture from the Arts and Crafts to contemporary Slow Design movements. But anthropologists have long acknowledged the mutability and diasporic nature of vernacular forms and their ability to

[4] My approach in this dissertation builds on prior studies of music and sound technology (e.g., Born 1995; Doyle 2005; Greene and Porcello 2004; Meintjes 2003; Novak 2013; Pinch and Trocco 2002; Rodgers 2010; Sterne 2003, 2012; Thompson 2004; Wood 2010) from a number of interdisciplinary lenses: ethnomusicology, historical musicology, sound studies, anthropology, sociology, and science and technology studies. In turn, I add a musical perspective to discourses in the posthumanities, media studies, and ecological thought (e.g., Bennett 2014; Hertz and Parikka 2012; Hirschkind 2006; Larkin 2008; Morton 2010). In addition to scholarly literature, I examined how-to guides, manifestos, and popular press articles written by DIY music technologists themselves.

> transgress, unsettle, and agitate cultures, as much as bind them. (Clarke 2011, 12)

In this dissertation, I approach musical and sound-producing instruments not just as objects, but as *designed* objects that are always *in the process of being (re)made*. In *Hertzian Tales*, scholar of design Anthony Dunne explores the "cultural function of electronic products" within a shared realm of experience he calls the "electrosphere" (2005, xvi). For Dunne, design is a strategy for linking imagination with reality, a "tale" with the designer as author/producer and the user as protagonist/co-producer. This strategy is realized through "conceptual design proposals offering a critique of the present through the material embodiment of functions derived from alternative value systems" (xvii), resulting in a kind of industrial, applied art. These "'material tales'…mix criticism with optimism to provide [a] 'complicated pleasure'" (ibid.). What is more, Dunne emphasizes a particular type of design he calls "post-optimal," which goes beyond the quest for user-friendly electronic products to stress "user-unfriendliness, a form of gentle provocation" (ibid.). In our typical interactions with designed objects, he muses:

> We unwittingly adopt roles created by the human factors specialists of large corporations. For instance, camcorders have many built-in features that encourage usage; a warning light flashes whenever there is a risk of "spoiling" a picture, as if to remind the user that he or she is about to become creative and should immediately return to the norm. (22)

My interlocutors are sometimes asked why they bother to create instruments that may not provide outright commercial or aesthetic value to vast numbers of people. I believe that conceptual, even post-optimal, design does indeed offer a complicated pleasure that is rewarding in its own right. Indeed, I link such pleasure to the realm of technoaesthetic value; we will see discourses of pleasure on such diverse topics as play and gamification (chapter 1) and visuals in music videos and album covers (chapter 4). DIY music technologists sense the "warning light" and press onward nonetheless, in search of knowledge, growth, and adventure.

Taken together, these and many other texts on making and design as a way of thinking about everyday life have led me to view the DIY music technology mindset as a matter of prototyping: the physical construction of novel, never-quite-finished objects and the application of this process to a sense of self. In fact, I view this endless sequence of new projects, of acquiring new skills, and trying out different stages of hobbyism to professional builder as a kind of *permanent prototyping*, a heightened, constant state of pursuit.[5] In each chapter, I develop various dimensions of this idea by investigating contexts—social movements, science experiments, ecological engagement, and music scenes—in which people use sound technology to model, critique, and remodel ways of being in the world.

The DIY Ethos

An emerging body of literature on DIY shows that it can be a method for a completing a homemade project, an inspiration for a movement (Anderson 2012; Hatch 2012), a model for political participation or protest (McKay 1998; Ratto and Boler 2014), an artists' manifesto (Ramocki 2009), and a mode of production and distribution (Luvaas 2012; Spencer 2008). Overall, I hold that DIY is an ethos, as defined by Clifford Geertz: "A people's ethos is the tone, character, and quality of their life, its moral and aesthetic style and mood; it is the underlying attitude toward themselves and their world that life

[5] Dunne would take this a step further, privileging the "genotype" of an idea at the core of the prototype, even if it is a failed or non-functioning physical model, over a working prototype (2005, 90). My use of prototype covers any physical model *intended* to function, whether or not functionality comes to fruition.

reflects" (1957, 421). For DIY music technologists, their ethos is at the core of their practice; it informs the kinds of projects they dream up and their methods for undertaking the building process. They often take this DIY ethos for granted, as an independent, hands-on, self-made approach to music technology that involves attacking a substantial learning curve through websites, books, and group workshops, and culminates in the construction of a tangible sound-producing object. Moreover, this process should enhance the builder's knowledge and skill set, and it should lead towards improvements for the builder's community (online, immediate friends, or physical community). In fact, "DIY" is a term with a wildly complicated lineage of shifting nuances of meaning and personal associations.

As a cultural concept, a useful starting point for the DIY ethos lies in historian Steven Gelber's (1999) work on the origins of hobbyism as a form of "productive leisure." Hobbyism "emerged as a category of leisure activity in the nineteenth century," according to Gelber (xi), and the rise of leisure time among a growing middle class elicited the view that what one did with one's free time was either "productive" or "destructive." The Protestant work ethic instilled a fear of idle hands, and hobbies became a kind of "socially valued" leisure activity due to their merging of work and play and of the public and private domains (2); thus, they "developed as a way to integrate the isolated home with the ideology of the workplace" (20).

Gelber also draws upon the work of sociologist Robert Stebbins, who calls such activity "serious leisure," which is meant to involve "specialized skills, reward perseverance, integrate participants into a specialized subculture, and provide them with benchmarks by which they can measure their achievements" (1999, 11). In fact, Stebbins created an entire framework called the "serious leisure perspective" (SLP), in which he distinguishes between gradations of amateurs, hobbyists, project-based leisure, occupational devotees, and more (all in further detail than is necessary here, as my interlocutors thrive among the gray areas of these boundaries, but it is nonetheless of interest for research on DIY). The SLP definition of serious leisure is

> the systematic pursuit of an amateur, hobbyist, or volunteer core activity that is highly substantial, interesting, and fulfilling and where, in the typical case, participants find a career in acquiring and expressing a combination of its special skills, knowledge, and experience (Stebbins, 1992, p.3). The adjective "serious" (a word Stebbins' research respondents often used) embodies such qualities as earnestness, sincerity, importance, and carefulness. This adjective, basically a folk term, signals the importance of these three types of activity in the everyday lives of participants, in that pursuing the three eventually engenders deep self-fulfillment.[6]

The extent to which "participants find a career" in DIY music technology is variable: anxieties about making a living are a vast undercurrent in my interlocutors' consciousness. Nevertheless, I will show, many treat their projects with impressive sincerity, regardless of whether or not an income is derived.

The concept of DIY as a kind of hobbyism arose after many jobs comprising hands-on labor were lost to industrialization. Gelber states that "…rather than viewing such productive leisure activities as a return to a golden age of labor, it is perhaps more useful to view them as exercises that serve to ideologically integrate work and leisure by permitting workers to engage in worklike behavior in a noncoercive environment" (1999, 19). Hobbyism suggests "a tendency to seek forms of work and leisure that express the same kinds of abstract values, such as freedom, creativity, and status" (ibid). The internal motivations can be divided into *compensatory* reasons, which add the life balance

[6] See http://www.seriousleisure.net/concepts.html.

missing from work, and *spillover*, which use skills similar to work, but these are not necessarily mutually exclusive (ibid.). In other words, hobbies are a “contradiction” that “challenge the easy bifurcation of life’s activities into work and leisure” (ibid., 23).

Gelber calls the 1950s the “great do-it-yourself boom”—in the United States, at least—in which the self-sufficiency required throughout the Great Depression and wartime efforts was followed by a return to greater leisure time and stability (1999, 5). The term “do-it-yourself” was used sporadically since at least 1912, and it skyrocketed after 1952 proclamation in *Business Week* magazine about a new “age of do-it-yourself”; a 1950s alternative, “how-to-do-it,” never quite caught on (269-271). Although the “home improvement” brand of DIY implied a sense of togetherness for suburban husbands and wives in the household (interestingly, Gelber cites an approving Margaret Mead on this topic), Gelber argues that masculinity was reinforced through the designation of home workshops and the choice of certain activities like fixing cars that would differentiate men’s hobbies from cleaning and child care activities (268-269). Thus, at this historical juncture, we see the beginning of the *workshop* as a privileged site of DIY activity.

In the 1960s, we see an offshoot of hobbyism and DIY in terms of a serious interest in the idea of “crafting.” This Arts and Crafts Movement came from the counterculture and had “an anti-industrial and anticapitalist” ideology, which “gave rise to a cohort of professional artisans and a generation of highly skilled hobbyists” (Gelber 1999, ix).[7] The 1960s also incubated the technique of circuit bending (Ghazala 2004),

[7] See Jessica Wood (2010) on the construction of DIY harpsichord crafting during this time. Wood questions why, at the height of the electric guitar craze, people suddenly wanted to build their own harpsichords.

and experimental electronic music already had a history by then; for instance, the Theremin was invented in 1920, synthesizers were in development all throughout the prior decades, and in New York, the Columbia-Princeton Computer Music Center was founded in the 1950s.

In Germany, technology behind the Iron Curtain existed in a lifeworld quite different from the West. In the former East Germany (the GDR, or German Democratic Republic, which lasted from 1949-1990), the press reported frequently and enthusiastically about the latest technological achievements, and successes were broadcast on the state TV network. This created the appearance that *everyone* in the GDR was well-equipped with the best of technological instruments; in reality, only a few major companies had this access, due to secret connections with the West that allowed them to circumvent the embargo and import equipment from Western businesses (Macrakis and Hoffmann 1999; Macrakis 2000). Such a situation impacted ordinary citizens behind the Iron Curtain, who had to get "more creative" (as my interlocutors put it; see also Böhme-Mehner 2011a) in order to obtain knowledge and materials. Though some GDR instruments that were virtually unheard of in the West did become immensely popular at home, [8] waning patience and money for research and development meant that technological infrastructure was crumbling and "DIY" was often less a choice than a reality due to a lack of access to materials and information (ibid.). (For an example of current DIY music technologists who consciously reference this "unchosen" DIY ethos,

[8] For instance, the MFB electronic instruments company, founded in Berlin by Manfred Fricke in 1976, produced one of the best-selling drum machines in Germany in the 1980s, the "drum computer" MFB-501; this product outsold the Roland TR-808 by ten times as much in some shops, yet it developed little to no international reputation. See http://www.mfberlin.de/Wir_uber_uns/wir_uber_uns.html.

see chapter 1).

The GDR soon switched from supporting localized inventions to focusing on Western imports or imitations, which were illegal to obtain (Macrakis 2000).[9] One present-day company I discovered with links to that time is Vermona, which has existed in various forms since 1954 and specializes in modular synthesizers and drum machines. (As a former GDR-based company receiving state funds, Vermona was forced to shut down operations in 1990, but it has since reopened.) Vermona's website depicts how, during the GDR era, a "painstaking" research and design process eventually became thwarted by Western advancements and trade embargo: "In the development and production of this instrument [the digital keyboard SK 86], the technical backwardness of the GDR became more and more noticeable."[10] The Vermona website has an "info" link that connects the reader to an undated *Freie Presse* article (likely from the 1990s) that describes how two *Bastlers*, or DIY hobbyists, became Vermona & Co. employees and struggled to build and market the Vermona Synthesizer during the GDR. The article describes how, in the early 1980s:

[9] Macrakis chronicles the GDR's technical espionage, citing a 1956 document that specifically states a goal to acquire secret documents and imports through the Ministry of State Security, or the Stasi. We can see this in the case of Agent Gorbachev, a physicist who spied for the East for 28 years. (Of course, technical espionage is not unique to East Germany, but what *is* unique is how much we know about it, a result of the Stasi archive later becoming available for public viewing.) She found that the GDR excelled at eliciting this secret knowledge, but she argues that "good espionage does not necessarily lead to good science," and that "East Germany may have saved on research and development costs in the short term, as was its espionage goal, but this sort of thinking led to long-term weaknesses in the science system." In other words, every time a technical document was smuggled in from the West, that was science that the East was *not* doing, forcing them to become dependent on the government for knowledge.

[10] See www.vermona.de.

> Devices by Moog, Korg and Yamaha sounded far more consistent and had memory for sound settings. "The Japanese were hopelessly in front, everything was just about special chips, since we had no chance…" [employee] Haller reminds himself. Western chips were needed, but had to be brought across the border almost unofficially. "Materials were brought in briefcases for a semi-annual production, while organs ready for the USSR were just waiting on this one component." Products such as the rhythm machine K2 were developed, in his words, "more out of gimmick," while all the Western tinkerers were working with new sophistication at Yamaha & Co. When, after *die Wende* [the turn towards reunification], the Eastern market broke away from Vermona instruments, it was over.[11]

Judging by other accounts of GDR technology, this description—and its further claims of black markets for Western musical equipment—is not surprising.

Nevertheless, the GDR had its own rhetoric of technological progress and instrument building. Microelectronics, for instance, became the keyword for progress and economic vitality. One propaganda poster on display at the Deutsches Historisches Museum declares: *Mikroelektronik im Sozialismus: Für das Wohl des Volkes* [Microelectronics in Socialism: For the Welfare of the People]. Although the government focused mainly on computing technology, electronic music technology, too, had a place in GDR policies. A fascinating example is the long-forgotten Subharchord, an early synthesizer that emerged in 1961 from a state research lab meant to rival Western advances in electronic sound. The Subharchord generated sub-harmonic frequencies below the overtone scale, allowing researchers to explore the theory of a naturally occurring undertone scale. Thus, its invention fit both the parameters of a state preference for pre-war "natural" music and "could also be regarded as an advancement of thought, a means to overcome natural barriers, a model [that] was integrated into the self-concept of the East German scientific system, which in turn propagated a model of absolute

[11] Author's translation; original at www.vermona.de.

progress" (Böhme-Mehner 2011b, 39). One of only a handful of Subharchord models disappeared following a visit from Norwegian scientists (no records were kept due to the trade embargo), while others were lost or fell into disrepair, until they finally began to reappear in the 2000s.[12] When instruments like the Subharchord and Vermona synthesizers attract attention today, we might refer to the phenomenon of *Ostalgie*, or nostalgia for products from the former East. This phenomenon is generally left out of the tech-savvy Germanophilia I discuss below, but it is increasing as more visitors to Berlin learn about German electronic instruments through specialty shops and websites.

Today, on the one hand, DIY has entered general parlance so broadly as to seem to evade precise meaning altogether. It can refer to such a wide range of home projects that one could not name them all: crafts, fashion, decorations, cocktails, and almost anything else can be DIY if you had a substantial hand in making it yourself. On the other hand, DIY as we know it today also became fused with the legacy of punk rock, fanzines, and independent record labels (Luvaas 2012; Spencer 2008; O' Connor 2008). Scholars such as anthropologist Brent Luvaas (2012), in his study of global DIY fashion and music, have struggled with the term's ubiquity and resistance to definition. Participants' allegiances to different associations with DIY, historically and socially, range from American men in the 1950s conducting home improvement projects to global youth movements for the non-commercial production of music and culture. It is the latter that substantially reframed DIY from the 1970s onward, through its connections with punk rock. Punk played an enormous role in "popularizing the term for a new generation, and forging a conceptual template of DIY that is still very much in use today," writes Luvaas.

[12] This was the subject of a documentary and an event at the 2013 CTM Festival, with more information available at: http://www.residentadvisor.net/feature.aspx?1771.

"Moreover, punk was never merely a sound. It was a fashion, a style of publishing, and a lifestyle choice" (11). Whereas Luvaas describes hanging out in Indonesian "distros" as sites of DIY culture—referring primarily to independent record and clothing shops—such sites barely exist any longer for my Western interlocutors, who find such brick-and-mortar shops have given way to shopping websites and must create their own venues and arts spaces as meeting sites. Nonetheless, these groups share a desired independent *approach* to the distribution of materials of the kind that Luvaas states encapsulates the "DIY ethos" for his work (xx).

Amy Spencer (2008) traces the concept of the DIY ethos along the lines of fanzines, pirate radio, and other "lo-fi" production methods, as participatory cultural activities with low barriers to entry that encourage the exchange of ideas. She defines "the 'do-it-yourself' approach to music making" as "all about producing your own music using whatever resources are available to you" (187) and draws special attention to the musical style of "skiffle," an amalgam of folk, country, blues, and jazz traditions and a precursor to rock n' roll that was popular among American and British youth in the first half of the twentieth century. Skiffle musicians often played instruments improvised from household materials, such as washboards, whistles, and kitchen utensils (following examples gleaned from African American musicians more generally) and set off a do-it-yourself band craze, from more professional gigs to "rent parties," spontaneous concerts held with the goal of raising immediate income for housing costs (187-194).[13] She cites this practice as a forerunner of punk rock techniques for opening up performance avenues

[13] My interlocutors continue to hold "rent parties" today, a frequent practice among residents in urban DIY spaces such as Death by Audio.

for everyday people, rather than only for musicians who passed through the gatekeepers of the corporate music industry. Although Spencer's work privileges "lo-fi culture" as subverting high production values (e.g., photocopied zines, self-recorded cassettes)—which at first glance seems to exclude the innovative technological curiosity espoused by many DIY music technologists—she also highlights a finer point: the DIY ethos is about providing *alternatives* to high-tech options and allowing vernacular voices to be heard.

Despite these anti-commercial tones, tensions of consumerism pervade the DIY ethos. Is it acceptable to derive an income from a DIY project, and if so, how much? Drawing in part on the promises and contradictions of "punk capitalism" (Mason 2008),[14] Luvaas states, "DIY production has always maintained a complicated relationship with capitalism, pushing away with one hand what it pulls to it with the other" (2012, 21). Indeed, my own interlocutors openly contest, subsume, and occasionally embrace capitalist approaches to instrument building. In the following pages, I explore such tensions in three major streams of DIY music technology, coming from underground/rock music, avant-garde/experimentalism, and the Maker Movement.

As I will discuss more thoroughly in chapter 1, the Maker Movement purports to revolutionize creativity and the means of production by sharing knowledge about DIY projects. The movement is only about a decade old but is already a global phenomenon that has its own magazine (*Make Magazine*) and festivals (Maker Faires). It merges DIY in the sense of electronics hobbyism and the idea of being an amateur inventor with the fast-paced business savvy of twenty-first-century technology start-up companies. As a

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[14] Although Mason puts forth ideas about "punk capitalism" as entrepreneurship with "purpose before profit" and "technology + democracy" in this text, my interlocutors would be loathe to support many of his examples, especially his exaltation of punk-turned-conglomerate Vice Media (see chapter 4).

result, it embodies numerous tensions between DIY as an *alternative* to or an *escape* from commercialism with the call to profit-driven entrepreneurship. (I will address cases from the World Maker Faire and businesses that put pressure on the acceptability of capitalism in DIY culture.)

Chris Anderson, author of *Makers: The New Industrial Revolution* (2012), is a life-long participant in various facets of DIY culture. He began tinkering with analog electronics as a child, was later a part of the Washington D.C. punk scene in the early 1980s, finally finding his muse in the Maker Movement in the 2000s. Anderson argues that DIY is growing to become not just a subset of culture but rather culture itself. He calls this "the long tail of things," or "the shift in culture towards niche goods," at a time when everyone who is not corporate has seemed to turn "indie" by default (63-64). He says this is "disruption by design"—by product design as well as in the distribution methods of these products—on a variety of scales, from the smallest community to the global marketplace. For him, the key to Makers' broad appeal is their attention to community and craftsmanship (68), while their timeliness stems from the importance of modification and customization in today's "remix culture" (74; recalling Lessig 2004, 2008). But when tinkerers formerly with few commercial outlets find themselves with many, what can we "call this new class of entrepreneurship, these cottage industries with global reach targeting niche markets of distributed demand" (78)? Anderson considers various takes on the core elements of DIY culture that are surfacing in the mainstream, from handcrafted artisanship to indie bands to boutique shops, settling on "small batch" as the common entrepreneurial thread (ibid.). Thus, for Anderson, the new industrial revolution is a *small batch revolution* run by entrepreneurs maintaining a DIY ethos.

Finally, the edited volume *DIY Citizenship: Critical Making and Social Media* (Ratto and Boler 2014) is a project stemming from the University of Toronto's "Citizen Lab" that studies and organizes a range of DIY activities into the themes of activism, making, design, and media. For the authors, DIY is "characterized by its emphasis on 'doing' and the active roles of interventionists, makers, hackers, modders, and tinkerers" (18), and they view making as a "critical" act when it intervenes in and reflects upon processes of power, authority, and relationships between people and the material world (2-3). Thus, they treat "DIY citizenship" as a "conceptual thread" for relating diverse participatory activities with a political component (7). Notably, however, music and sound are not included in the volume. I believe this dissertation begins to address these gaps in the audible aspects of making (and capital-M "Making") through my experiences with "critical making," "citizen science," issues of sustainability and materiality in the building process, and DIY venues as a site for structuring both products and engaged community.

DIY SOCIABILITY

Despite Anderson's provocative claim that everyone is turning "indie" by default (2012, 63-64), I suggest it is reasonable to view the loose sense of community comprising networks of DIY music technologists that I consider in this dissertation through the lens of Michael Warner's "counterpublics" (2002): my interlocutors are a group that separates themselves from the public at large through the cultivation of specialized knowledge, particular modes of socialization, and a critical relation to existing power structures. As Warner writes, counterpublics produce "friction against the dominant public, thereby forcing the poetic-expressive character of counterpublic discourse to become salient to consciousness" (57). Once created, counterpublics occupy a tenuous role between negligible circulation and entering the mainstream, the latter of which would entail "risking the humiliating exposure of inauthenticity" (73). The ideals and anxieties of DIY autonomy and counterpublics intersect to present a certain sociability and unique aesthetics, which I trace in this dissertation through a study of DIY music technologists.[15]

DIY music technologists have loosely based modes of partaking in stranger-sociability[16] mediated through discourse in person and online, informal economies, and locally planned events for networking and sharing designs. Additionally, participating in these events means that individuals are generally aware on some level of their membership in the group, although it is a highly mobile and flexible type of belonging that can intertwine with many others. The results of this artistic labor remain vulnerable to judgment on the basis of their cultural "expediency" (Yúdice 2004), in which institutions and individuals assess DIY music technology's role in technical skill-building, social problem-solving, and economic stimulation. When metrics of value and creativity arise, they expose a complicated relationship between technological progress, humanistic inquiry, and the value of music. Consequently, in what follows, I will document how the cultural labor of DIY music technologists hinges on an ethics of

[15] Although my use of Warner here was developed independently, I am not the first to make this connection to music. For instance, in David Novak's analysis (2013), it is not surprising that the case of "noisicians" lends itself to the same framework, and his book has since strengthened my conviction about this.

[16] Gaonkar and Povinelli describe stranger-sociability as "a self-reflexive collective agency built around the reciprocal performative action of participants who, though strangers, have equal and direct access to one another" (2003, 391).

autonomy, encapsulating tensions of global capitalism and consumerism, and is measured through a blend of social and economic factors.

Following my interlocutors' use of the term "folk technology" (see chapter 1), I consider DIY music technology a vernacular art form—an everyday creative and discursive practice that uses accessible tools and materials while forging a widespread community basis. In this dissertation, I link folk technology to an expanded conception of "hacking"[17] to articulate how this phenomenon exemplifies the technological vernacular by opening up the "black box" of musical objects once considered off-limits. The notion of the "black box," a term frequently encountered in science and technology studies, sheds light onto how the DIY ethos mediates human-machine interaction. According to Bruno Latour, "blackboxing" encompasses "the way scientific and technical work is made invisible by its own success. When a machine runs efficiently, when a matter of fact is settled, one need focus only on its inputs and outputs and not on its internal complexity. Thus, paradoxically, the more science and technology succeed, the more opaque and obscure they become" (1999, 304; concept first introduced in Latour 1987). When DIY music technologists open the black box of built objects, they combat the "indifference" of "technological somnambulism" (Winner 1995).

On Sites of Encounter: Pursuits

As I alluded to above, DIY music technology is not electronic music but rather a particular way of approaching the use of electronics in music. It is characterized by

[17] "Hacking" is a major theme among my interlocutors that refers to the rewiring of electronic circuits for purposes unintended by their original creators—or, more broadly, the reassertion of agency into standardized chains of production. My interlocutors also sometimes use the term interchangeably with words like making, bending, and tinkering.

exquisitely overlapping identifications: it is not quite a *scene*, not quite a *genre*, not quite a *subculture*—hence my designation of it as a *counterpublic*—but it is also all of these things. This somewhat ambiguous constitution led to a number of challenges and opportunities while I was conducting ethnographic fieldwork.

I first conceived of the phrase "DIY music technology" while conducting research in New York City for a master's thesis in 2009-2010. After attending a concert at the DIY music venue Death by Audio, I heard that the owners of the space also built their own guitar effects pedals (see chapter 4 for my analysis of Death by Audio). As a guitarist myself, the allure of these homemade pedals made sense to me. In my first interview with one of their former pedal builders, however, I learned that people interested in building pedals often did not stop there; they also might also engage in activities and use technologies I had never heard of, such as circuit bending and Arduino, and they constructed instruments that did not resemble musical instruments to me at all. DIY music technologists are comprised of clusters based upon varying curiosities and identifications, and these clusters maintain significant overlap. My journey to understand the range of DIY music technology led me to learn skills and terminology previously foreign to me as an ethnomusicologist, from soldering to coding, and to strive to understand the importance of these activities to my interlocutors, many of whom started from scratch themselves.

To take another example, I saw the trio Burnkit2600, who describe their genre as "experiments in electronics," perform sets with their circuit-bent instruments in three very different contexts: at Bent Festival (2009), at a booth they hosted for "open jam sessions" at Maker Faire (2014), and at a workshop called "Square Wave Oscillators

101," for chiptune fans at Blip Festival (2012).[18] These three festivals cater to different crowds with overlapping interests, and Burnkit2600 traverses this shared terrain by maintaining fluency in multiple areas of DIY music technology. Audience members encountering one of their sets might register Burnkit2600 as a "band" with an experimental electronic music-meets-progressive-rock feel, tinkering with a mix of analog and digital electronics that include modified/"bent" toys, drum machines, and synthesizers, as well as an array of custom-built and unmodified instruments. In a less typical move among my interlocutors, they have also released albums and tracks for digital download, such as the "anthemic" *Sonic Sanctuary* (2012) and an interpretation of dub tracks recorded live in 2011. Most recently, they have participated in a TED talk event for teenagers, performed at a "music hackathon," and demonstrated their wares at a local library. This blend of performance venues and contexts for building and sharing their sounds highlights the fluidity of DIY music technology as a practice without clear boundaries or one key shared feature but with "family resemblances" (in the Wittgensteinian sense of overlapping similarities rather than essences)—an amalgam of "experiments in electronics."

My quest to observe the full variety of DIY music technology has brought me to conduct fieldwork through concerts, festivals, lectures, interviews, how-to guides, material objects, videos, and online forums. Perhaps most importantly, the small-group workshops proved particularly distinctive sites of analysis in my study. Workshops, as I explain in chapter 2, are a rite of passage—a somewhat flexible ritual—for DIY music

[18] Chiptune, also called chip music or 8-bit music, is based on the sound chips found in retro video game consoles and outdated computers. The Blip Festival ran in New York from 2006-2012, with offshoots in Europe, Japan, and Australia.

technologists, in which they leave the comfort of their studios and computers and join together to improve their skills in a communal setting. These workshops can take place as stand-alone events, as part of larger festivals, or in conjunction with, for instance, a lecture or record release. They can last anywhere from one hour to a few consecutive days to recurring weekly meetings, and I estimate that the average workshop in my fieldwork lasted multiple hours in a single day, such as the micro_blackdeath noise synth workshop I describe in chapter 2.

Musicians' kits are extremely popular for both solo use and for building together during workshops, with a small sampling including the littleBits synthesizer kit, which uses Lego-like circuits that snap together; the Drawdio electronic pencil, which "lets you draw musical instruments on paper"; the MaKey MaKey, which uses an Arduino and alligator clips to "turn anything into a key"; and the Moog Werkstatt, a modifiable analog synthesizer designed for how-to workshops at Moogfest 2014 that was subsequently released to the public in light of high demand.[19] As the Moog Music company highlights, "Analog synthesizers have long had their *own maker culture* born of curious engineers, physicists and hobbyists who have created and crafted their sounds through electronic experimentation" (see website; emphasis mine). To meet public interest in the *new* Maker culture, Moog created a website to accompany the instrument, WerkstattWorkshop.com, intended as an "interactive creative learning portal containing project ideas, mod tutorials, parts lists, educational lesson plans, 3D printer files, and everything else involved with learning and modifying your Werkstatt" (ibid.). The focus on education is

[19] The Moog Werkstatt's website is http://www.moogmusic.com/products/werkstatt/werkstatt-01-moogfest-2014-kit.

paramount, and this education is aimed not just at tinkerers and musicians but also at students and teachers in science and technology classrooms, "encouraging a creative deployment of practical skills in these fields" (ibid.).[20] Meanwhile, users are asked to give back to the Moog "community" by sharing their own lessons, sounds, and ideas through an open source model.[21]

Finally, if this dissertation could be *heard* rather than read, one might question why there is so little "music" in a work on music technology. My interlocutors are generally unconcerned with what music "is" or where its boundaries lie. In chapter 4, I describe rock bands for which songwriting in the vein of popular music is of utmost importance; yet, as Derek Holzer demonstrates above, leaving music behind is liberating for many. My project is less about musical analysis than it is about the potentialities of musical production—tools, techniques, and the social networks that surround them. As with scholars of audience reception, I decenter "the work," "the performance," and "the recording" as privileged sites of analysis. This story is not (just) about "the composer"

[20] Attempts to break through to the classroom environment are also not new for synthesizer companies, as Paul Théberge (1997) found. Brian Kehew, the Bob Moog Foundation Archive Historian, noted in 2010: "Well into the 1970s, Moog kept trying to crack the large 'school market', designing and offering synthesizer packages as being 'educational'. Moog was not the only company to think this way–almost every manufacturer knew the large number of schools–and their associated budgets–and salivated at the thought of 'a synthesizer in every classroom'." Synthesizers were far from being placed in every classroom, however, despite their relatively greater success at the university level, and popular musicians ended up bringing the instrument to the masses. From: http://moogfoundation.org/mooghistory-unveiled-brian-kehew-explores-1965-r-a-moog-co-electronic-music-workshop.

[21] Note also the German term *Werkstatt*, or "workshop." Supposedly, this linguistic choice is a coincidence (Kirn 2014), but it may also reference the German group Kraftwerk, who headlined the 2014 festival. Regardless, this name remains at least a nod towards German experimentation in music technology.

and "the performer" but rather what we could term "the builder" and "the maker": my interlocutors are makers of materials, tools, instruments, and sounds.

On Sites of Encounter: Locales

DIY music technology is a phenomenon that occurs worldwide. In order to understand which aspects are unique to New York and which pertain more broadly, I found my way to Berlin in 2012-2013 as a contrasting field site. Thus, this dissertation is a multi-sited investigation that traces the movement of people, objects, and ideas as they circulate physically and virtually. New York and Berlin lend themselves to concentrated study due to their status as metropolitan areas ripe with opportunities to partake in DIY music technology as a localized, social endeavor.

Situated in a transnational center for music technology, DIY music technologists in New York—and their products and ideas—travel globally: commodities are sold, websites follow the progression of events, and people cycle in and out of the area. It also seemed a natural enough place to begin: not only have I resided here for my graduate training, but it has been home to events such as Maker Faire, Bent Festival, and Dark Circuits, as well as to venues hosting regular group workshops such as Harvestworks, 3rd Ward, and Brooklyn Brainery. As will be seen throughout this dissertation, I also watched as events migrated mostly out of Manhattan into other boroughs (primarily Brooklyn, but also Queens).

Meanwhile, my interlocutors also recognize Berlin as an international hub of electronic and experimental music, and the city offers a vibrant artistic environment. Another reason for my interest in the latter city is that its relationship with technologically-mediated popular and independent music scenes is currently better documented in the popular press and in brief studies than in longer-term scholarly engagements. One journalistic source that drew my interest initially was *The Economist*'s online cultural magazine, which called Berlin the "future city of music" due it its international artistic environment and innovative music technology start-up companies (Morgan 2011). These start-ups include Ableton, Native Instruments, and SoundCloud, the latter of whose co-founder, Alexander Ljung, states, "'…Berlin could become an amazing place for a lot of experimental musical instrument devices and tools'" (ibid.) Since that time, nearly every month brings a new hyping of Berlin as a utopia for both music and the DIY ethos. The latest, as of this writing, includes video interviews stressing the "typical Berlin DIY culture" embodied in new sites like Klunkerkranich, an artfully disheveled cultural complex with a restaurant, event space, sandbox, and other accoutrements (Wilder 2015). I investigate such claims in chapter 1, balancing the hyperbole about Berlin's potential with questions about what such technological optimism means.

Among the relevant academic studies of contemporary music in Berlin is Luis-Manuel Garcia's (2011) exploration of "techno tourism" in Berlin's electronic dance music scenes. A body of literature is also surfacing on immigrant youth culture that includes such topics as Turkish hip-hop (e.g., Soysal 2004). Geographers also point to Berlin's outsized role as a hub for the creative industries compared to its overall economy. "Berlin booms—but only with respect to culture and more specifically music," write Bader and Scharenberg (2010, 76). They argue that Berlin has thrived to become an "alpha" city for creative industries because of its rebellious, risk-taking, subcultural image, despite (and, conversely, because of) the fact that it lacks the same status economically. This, they assert, is due to repeated deindustrialization, both after World War II and after the country's reunification, as is also covered in broader accounts of Berlin's history (e.g., Ladd 1997).

In their study of Berlin's "creative clusters" that emerge in the trendy neighborhoods of Kreuzberg and Prenzlauer Berg, Barbara Heebels and Irina van Aalst (2010) analyze the city's "utilitarian value of place" (opportunities for networking, affordable and flexible facilities for rent) and its "symbolic value of place" (intangible aspects such as proximity to cultural gatekeepers, inspiration, and reputation) for artistic entrepreneurs. These neighborhoods have been known for decades as a "place of refuge for dissidents and artists" (360), yet "…for all entrepreneurs the physical environment is important for reproducing and strengthening their and their companies reputations for being 'creative'. In this sense, place becomes a marketing device" (ibid.)

The practice of building music technology occurs in locally contextualized sites of engagement, whether in the privacy of one's home or in a communal space; however, in light of the increasingly accelerated virtual environment, this practice is not bound to or determined by any one place. In other words, DIY music technology does not happen simply *because* of New York or Berlin, but such cities do facilitate it in unique yet globalized ways, offering an appropriate infrastructure and local environment. Interested parties congregate in these places, creating a network of likeminded participants of which the nature is worth examining more closely in each site. For example, Dorkbot, a New York-based social gathering at which participants informally present new works bridging the arts and technology, has spread to over 100 cities, including Mumbai and Sao Paulo;

meanwhile, the last Bent Festival for circuit benders (2011) took place in Brooklyn but included acts from Mexico City and Buenos Aires.

In whichever location they occur, challenges remain for keeping these events and innovations intact. Barriers of access to science and technology—and their application to the arts—are the first level of obstacles: gender, socioeconomic status, educational background, and other demographic factors can all contribute to the self-selection of participants and inform their experiences. The second level arises from *continued* access to resources, such as government funding for art and technology projects, university or non-profit connections, the perceived potential for advancement (economic or socially), and urban infrastructure. As I stress throughout these chapters, my interlocutors' perspectives arise from a Western cosmopolitan context. The demographics skew largely (though not entirely) towards white, college-educated males between the ages of 20-40. Yet DIY music technology, like other kinds of experimental and electronic music, is characterized by an assumed erasure of class, race, and gender. Science and technology, it follows, should transcend difference, but scholarship has repeatedly shown this to be untrue in practice (Born 1995; Haraway 1991; Rodgers 2010; Waksman 2004). Women are active participants at the beginner stages, but they seem to taper off as the ranks grow more "professionalized."[22] One final point of note is that my interlocutors are not

[22] My interlocutors, including women, repeatedly showed dismay and uncertainty as to why this occurs, and I have recently witnessed numerous gestures to provide a more inclusive space and to proactively feature women at events. I have also noticed a vague increase in the gender and racial diversity of beginners in workshops, although the breakdown does not follow a statistically significant pattern. Like Kafai and Peppler (2012), I have some concerns that women interested in electronics are being overly prodded into the zone of Maker activity separated as "crafting," which features projects like "e-textiles" that are more traditionally gendered female and technologies like the "LilyPad" version of the Arduino. Together, these observations will be the subject of a

uniformly college-educated, and of those are who are, few are financially secure. The economic uncertainty looming in Europe and America in the early twenty-first century underlies their decision-making processes, as we will see in each of my chapters.[23]

Berlin and the Germanophile Imagination

In prevailing cultural stereotypes, modern Germany is equated with machine-like precision and efficiency, perhaps more so than any other country. A reputation for high-quality, thoroughly reliable technical craftsmanship precedes German music technology. Such stereotypes by American, British, French, and Russian observers emerged at least a century prior, relating both to orderly administration and industrial prowess;[24] they became even more entrenched in the American imagination following World War II, when West Germany's *Wirtschaftswunder* (the 1950s "economic miracle" of postwar recovery) established the country as a skilled, stable world power. In a divided Berlin, the western part of the city, though technically a part of West Germany, was "islanded" as a

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future study. Of the available literature, I refer readers most of all to Tara Rodgers' interviews with female electronic musicians (2010). On masculinity, see Waksman 1999 and 2004 on tinkering with guitars, Perlman 2004 on the customization of audio gear, and Keightley 1996 on domestic gendered spaces for listening to audio gear.

[23] See debates on the "precarity" of creative labor (Neilson and Rossiter 2008).

[24] This stereotype of efficiency was often contrasted with liberty, industriousness contrasted with inspiration (Eliot 1915); see also the entire issue of the April 1915 *Atlantic Monthly*, in which contributors fervently debated the "German spirit," in the twilight years of the Prussian monarchy. In addition, deeply ingrained "Prussian virtues" were said to include traits such as discipline, orderliness, bravery, and loyalty; yet the more sinister flipsides of these traits struck non-German Westerners as "unthinking obedience, contempt for human life, humourlessness, militarism and inhuman severity" in the twentieth century (Dwyer 2014, 2). During my stay in Berlin, I occasionally overheard heavily-accented English speakers joking that someone or something was "so Prussian."

center-periphery within East Germany; by the 1960s, it felt like "the farthest end of the western world" (Schneider 2014, 75). The Wall itself, meanwhile, was "antithetical to the mobility and circulation characteristic of a modern city" (Ladd 1997, 19). From this position, West Berlin's "subsidized economy, peculiar legal status, and frontier allure meant that artists, draft dodgers, and nonconformists (but also pensioners) were overrepresented, businessmen and factory workers underrepresented in its population" (12). After reunification, Berlin, now part and parcel of the same social context as the former East Germany, struggled economically. The city retains some of this legacy today: relatively low rents, a lack of jobs, a surplus of artists, and ample space for converting old buildings into music venues. This scenario has made the city very attractive to international musicians, particularly New Yorkers disillusioned with an increasingly expensive, commercialized urban landscape.

In my study, I encountered more American musicians and sound artists coming to Berlin than vice versa. (In fact, my interlocutors in Berlin were a more eclectic, international crowd in general.) The New Yorkers seemed enchanted with Berlin, and if they had visited, they tended to wistfully recall their time spent in the city. Moreover, they seemed enthralled with German technology and with the imagined lives of the musicians who reside or resided there (particularly rock and electronic groups). The fact that David Bowie, Nick Cave, and Einstürzende Neubauten once lived in Berlin (and, elsewhere in Germany, Kraftwerk, Can, and related groups) seemed like a perfectly reasonable explanation to visit or even relocate entirely. My interlocutors did not expressly prefer electronic dance music and techno, but the "serious" DJ scene was still a draw because it meant that somewhere out there, a party was always raging into the morning. Better yet were underground music venues and shops in unexpected places: for instance, the venue West Germany, which hosted underground rock shows through entirely word-of-mouth promotion, and Schneiders Laden, a tiny analog synthesizer shop with a cult following, were both hidden near a Kaiser's chain supermarket in Kreuzberg. West Germany could be reached through an unmarked door at street level, while the shop required a Kafkaesque trek through seemingly private property and up onto the building's roof.

The twentieth-century Anglo-American musical imagination has often conflated and condensed German geography, while creating a mythology surrounding musical styles. In the 1960s-70s, the British popular music press proclaimed "Krautrock" (using the derogatory name for Germans, *Krauts*[25]) a scene and a genre of sorts. An imprecise and disputed term then, as it is now, Krautrock comprised German rock music characterized by its use of electronic instruments and influences, a blend of eclectic styles—such as avant-garde, improvisational, progressive rock, and psychedelic forays—and a steadily driving 4/4 *motorik* rhythm that was said to distinguish its German unfeelingness in distinction to Anglo-American blues-based rock. The press, eager for a coherent scene to hype, ignored that many of the bands lived in far-flung cities without explicitly shared influences and seized on German stereotypes in its descriptions. In preparing his book on the subject, David Stubbs found that none of the associated bands agreed with the term or conceptual premise of Krautrock (he jokes that "Teutonic Railroad Rock n' Roll" would also be a humorously apt description); instead, he

[25] Although the use of "Kraut" stems from *Sauerkraut* and was used to denigrate Germans (particularly German soldiers), during the world wars, *Kraut* simply means *herb* in German—an oddly amusing choice for a genre description when decontextualized.

approached them as "experimental German music of the sixties and seventies" (2014).

As purveyors of both Krautrock and electronic music more broadly, Kraftwerk has loomed especially large in the American imagination. They exemplify not only the advent of electronic music as experimental-popular crossover but also the juxtaposition of the "folk" and the "electronic." "Kraftwerk's subversive renegotiation of *Heimat* ["homeland," typically recalling nostalgic Alpine folk scenes] into a modern industrial context is sometimes countered by a self-conscious and knowing adoption of German cultural stereotypes," write Sean Albiez and Kyrre Tromm Lindvig (2011, 22). In interviews, they portrayed an intensive work ethic by calling themselves music "workers" (*Musikarbeiter*), drew attention to their mastery of technology, and referred to their music as "industrial folk" (22-23). Kraftwerk and the so-called Krautrock bands left a lasting impact on experimental rock and noise bands worldwide, and their strange relation to German-ness complicates the idea that technology renders sound from both everywhere and nowhere (see, for example, Albiez and Pattie 2011; Novak 2006). Not only has their influence entered global musical circuits from American to Japan but, in projecting an everyman version of technical mastery, I believe they have helped equate tinkering and labor as a kind of everyday musical genius worth striving for. When treating electronics as a form of productive leisure, anyone can be "German."

To be clear, I am not stating that all of my interlocutors are conscious Germanophiles; rather, such imagery of music technology seeps into their perceptions of Germany and German-ness, and, in some cases, prompted them to travel or move to the country.

American Constructions of Experimental Music

The outcome of DIY music technologists' tinkering can often be considered a kind of "experimental music." The outcomes vary by participants' interests in conforming (or not) to any existing genres, so that people who already play rock music tend to incorporate their experimental instruments into a rock setting, people interested in making sound art will pursue projects in that vein (this includes visual, performance, or multimedia artists learning to work with sound), and others who do not intend to perform or exhibit their work might simply build a prototype to see what sounds they can coax from it as an end in itself. I refer to this as a *filtered experimentalism*, meaning that an experimental paradigm is applied to the creative process but is colored by prior generic allegiances, goals, and experiences.

In the Western avant-garde, "experimentalism" often recalls a canon of twentieth-century composers that includes Henry Cowell, Harry Partch, Pierre Schaeffer, Karlheinz Stockhausen, John Cage, David Tudor, Pauline Oliveros, and Alvin Lucier, among others. But just as David Novak found while working with Japanese noise musicians (2006, 350-355), I found my interlocutors are only sometimes steeped in this history, even if it precedes and pervades their work without their being aware of it.[26] In my experience, once DIY music technologists learn about Cage's experiments with prepared instruments and Tudor's opening and rewiring of electronics, they are intrigued and want to learn more. Where this classic lineage of American experimentalism most resonates with my interlocutors, however, is in the role of the "everyday." As Benjamin Piekut

[26] For example, even Reed Ghazala, the "father of circuit bending," undertook this activity without knowledge of Tudor and the Composers Insider Electronics collective.

(2011) puts it, "[L]ike any other avant-garde, experimentalism performs not simply a return to daily life but an intensification of it—a peculiar mix of the commonplace and the singular. Experimentalism is both ordinary and extraordinary. It is the everyday world around us, as well as the possibility that this world might be otherwise" (2).[27] My interlocutors build with materials that are often part of fabric of their everyday lives—old speakers, empty canisters, light bulbs, circuit boards, toys, et cetera—and turn them into highly conceptual sound-producing objects.

The most direct link to this lineage is through an influential book in the circuit bending community, *Handmade Electronic Music: The Art of Hardware Hacking* (Collins 2006), which I first encountered at the 2009 Bent Festival. In it, project assignments are interspersed with reflections on forerunners of the practice. For instance, a chapter called "Circuit Sniffing: Using Radios and Coils to Eavesdrop on Hidden Electromagnetic Music," lists required parts and equipment, distills what "hardware hackers" might find interesting about radios and coils, and briefly connects the project to moments of historical importance (e.g., pieces by Lucier and Stockhausen and the invention of the electric guitar pickup). My interlocutor Phillip Stearns has followed in this tradition, citing influences including David Tudor, George Lewis, and Douglas Repetto (2009), in addition to an array of circuit benders and glitch artists. In contrast, when I asked Death by Audio founder Oliver Ackermann how he got started, he lent me his beat-up copy of Craig Anderton's *Electronic Projects for Musicians* (1992 [1975]). Why would this rock musician choose Anderton over Collins? While the book is

[27] Piekut also acknowledges "connections and confrontations" between various avant-gardes, particularly American experimentalism, European avant-gardism, and jazz (2011, 4-5).

considered a classic how-to guide for "musical electronics" in any genre, Anderton's background as a rock guitarist and other publications like *Do-It-Yourself Projects for Guitarists* (1995) adjust his appeal towards more of a popular music readership. It is interesting to note that, as of the time of this writing, Amazon.com lists three books as being "frequently bought together": Collins's, Anderton's, and Ray Wilson's Maker-oriented offering *Make: Analog Synthesizers* (2013), which collectively represent the three primary steams of DIY activity in this dissertation. As we shall see throughout the following chapters, DIY is filled with entanglements between the "experimental" and the "popular," leaving DIY music technologists who use similar technologies to invent their products—and themselves—differently, hearing what they want to hear and presenting themselves as who they hope to become.

Interrupting the Flow? On Circulation and Weirdness

My interlocutors are, on the one hand, expressly mobile, as they physically move between cities for residence, festivals, and other events; on the other hand, they are always at least somewhat *tethered to their gear*. Setting up a workspace in a new location is difficult when ones tools consist of elaborately scavenged and curated materials accumulated over years. Over the course of my research (admittedly a small segment of my interlocutors' entire career spans, if they choose to continue building for decades), I have witnessed many relocations within cities, but few between larger regions, countries, or continents. More than one builder has bemusedly warned me about air travel with experimental instruments, the unconventional designs of which may evoke explosive devices. Moreover, moving away threatens to be a lonely experience. As Eric Schlappi explained to me in my first interview in 2009, "Brooklyn is where the weird kids go, and the weird kids build stuff."

Taking cues from studies that complicate circulation as unbridled flows of exchange by focusing on failure, obduracy, and feedback loops (e.g., Larkin 2008; Novak 2013; Steingo 2015), we might also invert this search for connections to also consider points of rupture or blockages. Depending on which topological analogy we choose, this might equate to knots or frays in the woven tapestry, dents in the sphere, or perhaps jams in the loop or web. In Western cosmopolitan hubs like New York and Berlin, infrastructures tend to run smoothly compared to those described in Larkin's study of Nigeria or Steingo's study of South Africa, and circulation has accelerated immensely in an era of high-speed internet and affordable air travel. But close observation of these sites also reveals more nuanced interactions and exchanges.

A lack of circulation can also keep things weird. Over the time I have conducted this study, I have witnessed a decrease in the self-identified "weirdness" I encountered in my earlier fieldwork. Most of DIY music technology still operates under the radar of the mainstream music industry; however, in a few short years, the Maker Movement has made these practices more mainstream—as Chris Anderson purported above (2012)—along with a rising institutional interest in multimedia and sound art (Columbia University's new Sound Art MFA program, Cory Arcangel's hacked/glitch art exhibit at the Whitney Museum in 2011, and the Museum of Modern Art's first sound art exhibit in 2013 being just a few examples). My interlocutors are positioned less as the solitary "geeks," "nerds," and "weirdos" and more likely as "artists," "Makers," and "creative technologists." The exploration of strange sounds remains, unmistakably, the guiding call to build—but one must ask what paths the institutionalization of weirdness might take as an aesthetic at this new juncture (we have, of course, seen this before, regarding various avant-gardes like jazz and computer music). I also contend that with more institutional opportunities available for pursuing these activities, those left out are, as ever, those lacking pedigree, reinforcing traditional divides between the "art world" and underground music scenes and foregoing opportunities to include more diverse participants.

Chapter Summaries

The following chapters are organized as narratives of discovery, reflecting how I came to understand the various themes associated with DIY music technology. In **Chapter 1**, "The Art of Critical Making: Instrumentality and Ethical Labor in the Maker Movement," I analyze the impact of the Maker Movement—perhaps the greatest transformational change to DIY music technology since I began the project—which purports to revolutionize technical creativity and the means of production by educating and encouraging individuals to learn creative technical skills blending technology and the arts. Although music and sound comprise just one portion of its concerns, the movement crosscuts many kinds of DIY building and has thrust interest in tinkering with technology into the public consciousness through a public relations-savvy barrage of how-to guides, electronics kits, and festivals. The chapter begins amidst the backdrop of New York's annual Maker Faire, a contemporary reimagining of the 1939 and 1964 World's Fairs that aims to put "the world of tomorrow" in the hands of the layperson. I then explore tensions between autonomous ideals of art and Makers' collaborative, socially-conscious approach, leading the reader through ethical quandaries about the utilitarian value of music posed by a Berlin startup company aiming to train children as Makers, an educational electronics toy featured at the fair, an instrument building workshop that modifies one of the movement's favorite tools, and a failed New York venue for hosting creative technical classes. As a result of changes in the broader economy coinciding with the rise of the movement, I argue that Makers locate music's value in its ability to shape future technical workers, who harness the science behind the sounds in hopes of rendering themselves employable.

Chapter 2, "The Aesthetic Virus: Experimental Instrument Building as Biophilia and Citizen Science," joins with new directions in experimental music studies (Piekut 2014) in registering musicians who consciously treat their work as a science experiment. I address how DIY music technologists use biomusic, tropes of virulence and contagion, and citizen science in ways that challenge Western conventions of modern science. These themes have been thrust into the public imagination through the rise of DIY biohacking, as exemplified by the "Bioterrorist Bach" character in the novel *Orfeo* (Powers 2014). I focus particularly on a case study of the "micro_blackdeath noise synthesizer," an instrument combining analog controls with computer code, inspired by literary and historical sources on the idea of the plague, in order to explore the symbolic roles of biological tropes and (pseudo)science in experimental instrument design. In deeming the engagement with science and technology an aesthetically valuable experience, the logic of DIY music technology does not preclude aspects of magic, the occult, or the uncanny; instead, it allows for the fetishization of the worldly and the extraordinary, of the scientific and the spiritual. In sum, experimental music, when viewed from the lens of the science experiment, creates space for participants to deftly entangle their roles as artists, inventors, and lay scientists, while complicating DIY music technology's role in narratives of secularism, science, and rationality.

Chapter 3 is "The Sounds of 'Zombie Media': Waste and the Sustainable Afterlife of Repurposed Technologies." Here, I examine the practice of material recycling, as well as its myriad permutations (reusing, repurposing, repairing, rescuing, reclaiming, salvaging, mending), as an anti-consumerist stance within DIY instrument building that values "making do" rather than making *more*. I show that DIY recycling nevertheless embodies contradictions in experimental instrument building (and particularly in the Maker Movement) about waste, particularly the issue of whether the act of "conspicuous production" is beneficial. I argue that DIY music technologists invest in recycling's social and ecological benefits in order to validate their roles as productive, responsible citizens. In doing so, I draw on media archaeology to address the non-linear temporalities elicited by this practice of incorporating "residual" materials and concepts into the building process, as seen in practices such as circuit bending, glitch, found object art, fixers' collectives, and experiments in forms of musical distribution.

In **Chapter 4**, "Blueprint for the Underground: Guitar Effects Pedals, Technoaesthetics, and Community at Death by Audio," I turn to discussing DIY in the context of a Brooklyn underground rock music scene and its search for uniquely noisy, guitar-centric technologies. This chapter draws on a longer ethnographic case study conducted intermittently from 2009-2015 at Death by Audio, a "boutique" guitar pedal business housed within a larger artist collective and music venue. I trace the arc of this group's development amidst rapid socioeconomic changes in northern Brooklyn, situating the pedal business in terms of a glamorized "new manufacturing" trend sweeping formulations of local small-scale artisanship. To understand the intertwined relationships between people, dwellings, communities, and technological objects, I theorize the idea of the blueprint as a (re)structural agent engaged in dynamic processes of creative flows, examining three types of "blueprints" that have allowed Death by Audio to thrive: the electrical schematics underlying the pedals, the architectural plan for the collective space, and the neighborhood zoning plans that reflect where artists can live and where people can build. As such, I examine the inner workings of the pedals, the aesthetics that inform the building process, and the social relations within the community that enable—even impel—sound technologies to take certain forms and functions to meet the needs of underground rock bands as well as builders as artisans.

Chapter 1

The Art of Critical Making:
Instrumentality and Ethical Labor in the Maker Movement

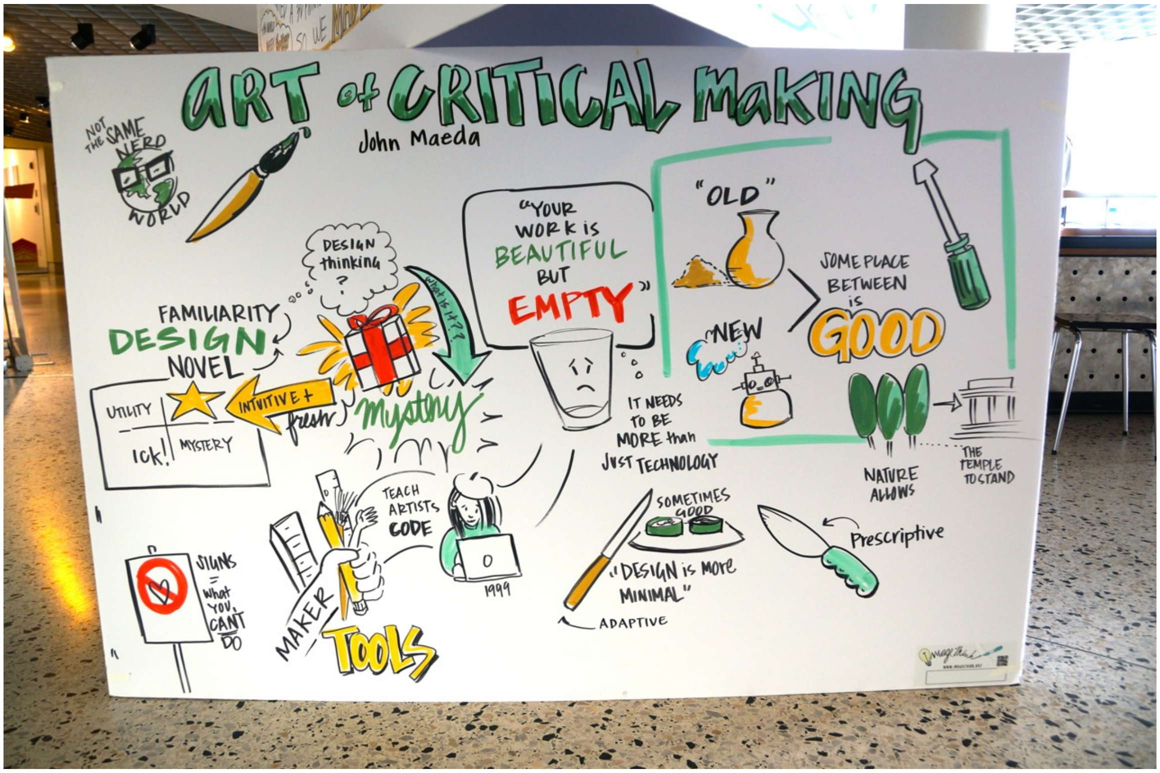

Figure 2. Maker Faire 2013 poster summarizing key points from the "Art of Critical Making" presentation

Maker Faire: Building the World of Tomorrow

In late September 2013, I seized a long-awaited opportunity to visit the World Maker Faire in its fourth annual incarnation. First realized in the San Francisco Bay Area in 2006, the fair's East Coast counterpart is held inside and outdoors at the New York Hall of Science in Flushing Meadows-Corona Park, Queens. The creators of Maker Faire (note the French version of "faire," meaning "to do," or "to make") seek to showcase

DIY talent and ambitions.[28] The fair is an offshoot of the Maker Movement, which began in 2005 with the publication of *Make Magazine* to channel activity alternately called DIY, hacking, crafting, building, or tinkering. The movement promotes personal empowerment—simply by learning how the things around you work—while providing a skill-based, amateur-friendly community for those interested in a variety of technical and craft-oriented projects. While *making*, broadly construed, is hardly a new human pursuit, the Maker Movement solidifies around a particular trajectory rooted in Euro-American hobbyism, a utopian futurist ideology mixed with a vernacular, low-tech approach, and a handful of favored tools and technologies (e.g., soldering irons and Arduino microcontrollers). Makers encompass a loose affiliation of likeminded individuals who associate with the movement to varying degrees, and they intertwine with DIY music technologists as though the two groups were part of a Venn diagram.

As the magazine's readership grew (along with its website, blogs, how-to guides, and online shop), sufficient public interest allowed for an annual gathering to flourish that is part science fair, part social gathering.[29] Typically a weekend-long affair, Maker Faire

[28] Peter Hirschberg, "The New York World's Fairs: 75 Years of Making Tomorrow," speech at Maker Faire 2013. Hirschberg explains the historical influences and current goals of the fair's founders. In keeping with the spelling conventions and usage for the original World's Fairs, I revert to the normative spelling of "fair" when not explicitly referring to Maker Faire as a proper noun.

[29] The Maker Movement is now a global phenomenon, although the bulk of its activity is still concentrated in the U.S. and Western Europe. The fairs, too, have proliferated quickly in just a few years' time. A short recap of this expansion follows: The first Maker Faire was held in the San Francisco Bay Area (2006-present), followed by the World Maker Faire in New York (2010-present); these two are considered the "Flagship Faires." (Other smaller fairs took place in Austin and Detroit in the intermittent years.) The Maker Faire website divides other fairs into categories of "featured, larger-scale faires produced in collaboration with Maker Faire," "current Mini-Maker Faires–smaller-scale, community-produced events," and "Mini-Maker Faire applications" for the upcoming

attracts both adults and children, juxtaposing a dizzying array of Maker-related offerings: tents for educational demonstrations of technologies, booths for Makers to display or sell their wares, lectures with invited speakers considered influential to the movement, technology-oriented games and rides, and an enormous shop filled with tools, kits, and books for purchase. That year's event proved overwhelmingly popular: some stations, such as the interactive “Learn to Solder” tent, were so packed that I had no chance of entering. Maker Faire (as with the Maker Movement as a whole) tends to emphasize and promote specific technological objects that it deems revolutionary: in 2013, the fair was saturated with 3D printers, Arduino microcontrollers, and Raspberry Pi microcomputers.[30] During my visit, I sought out projects related to music, sound, instruments, and technologies that might contribute to their creation. With a few notable exceptions, such as a MIDI-playing Tesla coil and an experimental percussion instrument called the Slaperoo, I was disappointed to find the sonic arts underrepresented at this fair; any examples I found were relegated to a corner of the fair, away from more attention-grabbing technologies.[31] As with the case studies I present later in this chapter, I was

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year. 2012 saw an explosion in Mini-Maker Faires (including the first fairs in Africa and South America). In 2013, 100 fairs in total fit into these combined categories; featured ones outside the U.S. took place in Toyko and Rome, the latter of which was widely anticipated by some of my interlocutors in Berlin. All levels of fairs continued to grow exponentially in 2014 and 2015, especially throughout Europe and beyond the West.

[30] Definitions of these technologies and their implications for DIY music technology are provided in case studies throughout this dissertation (excluding Raspberry Pi, which did not figure prominently in the musical projects I encountered). When I returned to the fair in 2014, it still concentrated on these items, along with the creeping addition of littleBits (examined below).

[31] In 2014, I found somewhat better representation of sound and music, although still in the minority of exhibitions.

struck by the pervasive blurring of art and commerce that foregrounded technology yet placed musical endeavors in the background.

The New York Hall of Science was home to the 1939 and 1964 World's Fairs, and the staging of the Maker Faire at this site is no accident. Though they appropriate the space that housed the World's Fairs, the organizers of Maker Faire subvert its dominant ideology: rather than provide a showcase of technological progress forged by experts, Maker Faire stages forums where those with little or no technological knowledge may experiment with the latest technological developments. But it is easy to see similarities between the Maker Faire and World's Fairs. As with Maker Faire, the gargantuan public expositions of the World's Fairs emphasized a utopian vision of "the World of Tomorrow," as interpreted by some of the biggest corporations in science, engineering, and technology and presented in layman's terms to the average citizen. Fair planners in 1939 made a number of idealistic statements leading up to the event that, when reviewed today, illuminate relations between the arts, science and technology, and the soon-to-emerge DIY ethos. Consider the following excerpts from a summary entitled "Social Ideals in a World's Fair" by New York architect Robert D. Kohn (1939), who served as Chairman of the Committee on Theme:

> The trouble [with interpersonal communication and collaboration] lies in the fact that as these facilities increase and our contacts become more universal, the freedom based on self-sufficiency has to give way to a new freedom based on understanding cooperation of many functions—an independence to be worked out in full recognition of our interdependence.
>
> ...[I]nstead of isolating science and art, the planners would attempt to show them permeating all of these other things, as illustrations of their interpenetration into the functions of modern life.

> "In the modern world," we explained [to early fairgrounds visitor H. G. Wells], "science is everywhere—commerce is everywhere—art should be in everything."
>
> The designers of the Fair this year are only trying to show the average visitor what things are available to him and, above all, what ideas and forces are at work which he should recognize as potential tools with which he, with his fellow men, would build it.

Kohn's summary is alternately a statement of utopian community-building and is patronizing to the fair's hypothetical visitors, seen as "the man who is ordinarily indifferent to serious discussion" (ibid.). The planners envisioned a fair that encouraged technological innovation and social communication on a personal/interpersonal level, but also, confusingly, as a top-down, business-oriented approach celebrating commercial triumphs that had to be translated for the layperson, who otherwise could not appreciate "progress."[32] In the years following the Great Depression, many visitors would have remained skeptical of big business, and would, indeed, need to be convinced of the value of commercialism (Samuel 2007, xx). In all the depression-era World's Fairs, writes historian Robert Rydell (2000, 11), a futurist utopia was the dominant theme; however, the message was driven home that stimulating the economy through consumer purchases would lead to that utopia, forgoing tendencies to save and thrift (and, by extension, to engage in what today we could term DIY practices).[33] By 1964, visitors did not require such forced optimism; fair organizers, however, continued to promote American capitalism as synonymous with progress. When some countries declined to participate

[32] Another then-contemporary description of the science at the 1939 World's Fair is "Science and the New York World's Fair" in *The Scientific Monthly* 48 (5): 471-475, by a correspondent listed only as J.M.

[33] Also see Rydell 2000 for a general overview of various political, economic, and social critiques of the world's fairs.

because the fair did not follow international regulations, eager American corporations quickly filled their spots. As Lawrence R. Samuel describes, the 1964-65 fair “would make all previous expositions pale in comparison in terms of their commercial nature” (2007, xx). However, the experience should not be dismissed as culturally meaningless: “Besides serving as a jumbo-sized promotional tool for marketers, the world's fair also, thankfully, offered visitors entry into a creative (and often surreal) wonderland” (xxii).

The influence of the Walt Disney Company in both the Maker Faire and the historical World's Fairs should not be overlooked. In 1964, Walt Disney Productions held four major shows at the New York World's Fair that left a lasting impact on the public consciousness; these displays were later shipped out to Disneyland in Anaheim, CA, and the World’s Fair as a whole inspired the EPCOT Center in Disney World in Orlando, FL (Nelson 1986). The exhibits featured Disney’s newly improved “Audio-Animatronics” system (filed as a trademark the same year), which debuted in the infamous “It’s a Small World” there and later formed the basis for popular park attractions such as Pirates of the Caribbean.[34] At the time, each show was sponsored by a different entity, such as Pepsi, General Electric, and Ford. Noting further similarities, Steve Nelson argues: “Making the familiar seem novel and the novel seem familiar is what EPCOT and the world's fairs are ultimately all about. The goal is to make the world appear both comprehensible and entertaining” (1986, 145).

[34] According to Disney World’s *Magical Kingdoms* blog, early Audio-Animatronics were controlled “by means of magnetic recording tape and solenoid coils. The signals recorded on the tape triggered solenoid coils inside the figures, producing action.” Accessed February 5, 2014. http://www.magicalkingdoms.com/blog/2008/07/08/the-history-of-disneys-audio-animatronics.

By the time of Maker Faire, Disney was in a financial position to sponsor something in its own right—the entire fair, in fact. “Presented by Disney” logos adorned the fair’s website and many of its on-site signs. A member of Disney’s research division also presented a talk on the Innovation Stage, entitled “Hacking the Un-Hackable: How We Can Make and Entire World Interactive.” There, principle research scientist Ivan Poupyrev showcased some of his lab’s recent inventions, such as plants that act as interfaces for music and underwater touch screens that sense a variety of human movements.

If we dive further into the sponsorship behind Maker Faire, the “DIY” waters get murkier. A fair of this size presumably requires some amount of sponsorships in order to exist, and candidates such as RadioShack[35] and Makerbot Industries make apparent sense. But Ford, Time Warner Cable, and Chobani Greek Yogurt? What could they want with the DIY community? On a governmental level, NASA is also a sponsor, and one featured speaker, Regina Dugan, formerly headed DARPA (the Defense Advanced Research Projects Agency, a sector of the U.S. Department of Defense). Upon examining the language and rhetoric expounded by the fair, the rationale behind these types of relationships becomes clearer.[36]

Much like the music industry as a whole, Western media technology industries have been upended due to advances in technology, business practices in response to these

[35] RadioShack played a part in Maker activities throughout my fieldwork and appears occasionally throughout this dissertation, although the corporation’s future has long been uncertain. As of 2015, it has gone bankrupt and is rumored to be undergoing a “rebranding” process under the unlikely guidance of actor/entrepreneur Nick Cannon.

[36] In his book *The Maker Movement Manifesto* (2013), for instance, TechShop hackerspace co-founder Mark Hatch lists some of his biggest “partners” as Ford, DARPA, and GE.

advances, and changing social norms regarding piracy and consumption (e.g., Johns 2009; Lessig 2004).[37] Scholars of popular culture often describe people are gravitating towards hands-on, interactive "experiences," as opposed to a passive consumer position (e.g., Benkler 2006; Lessig 2008). Presumably, larger technology companies, as well as the government, would like to seize the opportunity to view fledgling inventions (and their inventors as potential employees) in order to expand their own success. As speaker Mark Hatch put it, funding a focus group to test product ideas could run $20,000.[38] Meanwhile, observing how people are already tinkering and innovating with technologies at Maker Faire costs only the price of admission.

The example of DARPA is especially germane to the issue of government interest in emerging technologies. Audio technologies have a long documented history of stemming from military inventions, especially resulting from World War II and the Cold War: e.g., the vocoder (Tompkins 2010), underwater submarine sounds (Helmreich 2007), Russian sonic-optical experiments (Smirnov 2013), and other types of "sonic warfare" chronicled by Steve Goodman (2010). In Berlin, the enigmatic Subharchord synthesizer and the Teufelsberg former espionage "listening station" stand as physical examples that have recently captured the public imagination. At Maker Faire, another DARPA employee, Bill Casebeer, sought to involve the Maker community in quite a

[37] Note that piracy can take on quite different forms and cultural roles beyond the cosmopolitan West (e.g., Larkin 2008; Simone 2006).

[38] Mark Hatch, "The Maker Movement Manifesto," speech at Maker Faire 2013.

high-profile endeavor: DIY neuroscience and the creation of an inexpensive brain scanner.[39]

On the one hand, there is reason to be suspicious of corporate and governmental interest. Makers must get economically savvy: as amateur inventors, perhaps without prior business experience, their ideas are ripe for exploitation—financially, intellectually, and ethically. On the other hand, interest from corporations legitimizes their practice and provides a path to income and recognition that remaining purely "DIY" does not. Maker Faire, then, fosters a vision of utopian progress achieved through creative, independent, socially-aware engagements with technology, while also allowing for rampant consumerism and top-down innovation. Although Makers dislike linear narratives of technological progress[40] out of a belief that the "high-tech" seems inaccessible to the layperson, vestiges of past World's Fairs peek through the DIY veneer at the New York Maker Faire.

Makers: Case Studies in the Value of Skill

In this chapter, I use ethnography to explore the tensions that are so central to the Maker Movement: tensions between, on the one hand, DIY-articulated values of progress and self-improvement through technology, ethical labor, and the promotion of technical

[39] As David Noble (1979) argued, such interconnections of science and technology innovation, corporate capitalism, and military endeavors are part and parcel of modern American technological history.

[40] Alternate models for this narrative are not uniform among Makers, however. Despite the rhetoric at the fair about the encroaching post-digital "Maker Age," I found attempts to historicize the movement unconvincing. For instance, one speaker discussed time as an upward spiral of progress, in which the Maker Age places us back in prehistoric times, but one "level" in the spiral above prehistory. See Anderson 2012 for more on Making as a "new industrial revolution."

education, and on the other hand, the presence of corporations and the pull towards profit-driven entrepreneurship. My approach towards the relationship between Maker culture and capitalism is informed by notions of culture, skill, and value—of culture as "expedient" (Yúdice 2003) and the utility of play (e.g., Miller 2012; Moseley 2013). Makers in New York and Berlin invest much time and energy in: 1) opening the black box of technological objects by increasing personal knowledge of "how things work"; 2) improving access to technology in order to promote agency and awareness of global technological developments; and 3) decreasing reliance on existing top-down socioeconomic structures for innovation and employment. However, Makers typically face limitations in capital and resources while discovering that they must partner with the corporate interests they initially opposed. If one desires to transition from "Making as a hobby" to "making a living," I show in what follows that he or she may feel forced to employ strategies that compromise DIY values, often generating unexpected results.

I examine four case studies that demonstrate these tensions between DIY and corporate ethics: the organization HacKidemia in Berlin, the littleBits "open hardware" start-up company in New York, the small musical instrument business Standuino in Brno, Czech Republic (which presented a workshop for Berliners), and the 3rd Ward venue in New York. First, HacKidemia enables children to play and build using sound and music, but their stated goal is to teach technical skills and to render them employable by future companies. Second, the creators of littleBits aim to make electronics more accessible and to encourage skill-building through play, but the affordability and educational value of their product remain in question. Third, the Standuino group uses objects from the Maker Movement in order to build musical instruments, but they celebrate a localized, staunchly anti-corporate version of DIY that distances them from the global movement. Finally, 3rd Ward was considered a valuable community space for providing DIY courses, from woodworking to electronics, until it abruptly shut down amidst scandalous business practices in autumn 2013. Each of these cases engages with the rhetoric of the Maker Movement and its resulting artifacts, showcasing where the movement offers potentially useful innovations for the "world of tomorrow" (in the spirit of the World's Fair), and where it falls short in its efforts to cultivate a global, creative sociotechnical revolution linked to patterns of independent, ethical labor practices rather than overt corporatism.

I do not believe it is coincidental that the Maker Movement exploded in popularity following the 2008 economic recession: my interlocutors found themselves navigating a society that was unlikely to have jobs awaiting them, and they learned that they might have to create their own forms of non-traditional employment. But I contend that the conditions of the recession, while generating and sustaining the Maker Movement, also complicate its relationship to the DIY ethos it espouses. In early-twenty-first-century New York and Berlin, are Makers truly DIY, or are they merely entrepreneurs of neoliberal design? I find that, for many Makers, the most important goal of their practice, rather than employment itself, is the process of gaining skills that render them potentially employable: self-improvement through technical skill-building, as centered around educational workshops and tools that engender learning.

Basteln and the Betahaus

In January 2014, social media accounts from the (arguably-DIY) realm of start-up technology companies were abuzz over a new article proclaiming Berlin the new

"European Silicon Valley" (Neate 2013).[41] The link from British newspaper *The Guardian* quickly made the rounds between London, Berlin, New York, and further afield, followed by robust sarcastic commentary debating the validity of the assertion and to what extent the hype-laden article might "ruin" Berlin's countercultural capital. But *The Guardian* was hardly the first to notice. In the popular press, *The Economist*'s online cultural magazine has called Berlin the "future city of music" due it its eclectic artistic environment and innovative music technology startups. These startups have included music software company Ableton (in 1999), hardware and software company Native Instruments (in 1996), and audio distribution website SoundCloud (in 2007), the latter of whose co-founder, Alexander Ljung, proselytizes Berlin as "'…an amazing place for a lot of experimental musical instrument devices and tools.'"[42] Meanwhile, a *New York Times* article offered that Berlin's artistic "hipness never translated into badly needed jobs for a metropolis that could not recover an industrial prowess that was wrecked by war and division," but that the current technology scene offers hope for the economy.[43] Like most DIY technology, the "DIY" aspect becomes a point of contention worth exploring: startups, whether using analog electronics or digital software, may face the prospect

[41] The original quote was attributed to Microsoft's manager for Germany, Christian Illek, who mused, "There is no other city like Berlin where the spirit of pioneering and innovation is so strong. If we succeed in implementing the ideas of startups into successful business models, Berlin will become Europe's Silicon Valley." This statement came on the heels of a new Microsoft "accelerator" for startups, opened on the city's most famously regal street, Unter den Linden.

[42] Quoted in Joe Morgan, "Future City of Music," *More Intelligent Life,* 2011, http://moreintelligentlife.com/content/places/berlins-music-scene?page=0%2C1.

[43] Nicholas Kulish. 2012. "Berlin Hopes Growing Tech Community Will Lift City's Economy." *The New York* Times, Sept. 17. http://www.nytimes.com/2011/09/17/world/europe/berlins-tech-scene-offers-hope-to-economy.html?_r=1&hpw.

becoming large-scale consumer products—and may also find their goals at odds with the artistic community. In this section, I investigate this technological optimism and the role of DIY in Berlin's changing cultural landscape.

I should note that the popular press already began tolling Berlin's death knell as "over" in early 2014. Such articles, especially those in *Rolling Stone* and *The New York Times*, tend to focus on the techno club scene.[44] Interestingly, the authors home in on a strong connection between New Yorkers fleeing New York (particularly from Brooklyn's trendier neighborhoods) and the oversaturation of tourists and expats in Berlin, as in the *Times*'s subheading "Brooklyn Bohemians Invade Berlin's Techno Scene." In New York, the "artist migration" from Manhattan to the outer boroughs due to rising rent prices has long been a topic of conversation, but talk of a mass exodus to Berlin is a more recent phenomenon.[45] While techno plays an essential role in Berlin's cultural economy[46]—and I, too, perceived some feelings of a New York "invasion" at times—my intention here is to highlight the contributions of other uses of technology in underground, experimental, and popular music.

To understand Berlin's growing start-up scene, one must investigate the role of coworking spaces, hackerspaces, and FabLabs as the public interface of Maker culture.

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[44] See: Turner, Zeke. 2014. "Brooklyn on the Spree." *The New York Times*, Feb. 21. http://www.nytimes.com/2014/02/23/fashion/Brooklyn-Bohemians-Berlin-Techno-Scene.html?_r=1. Rogers, Thomas. 2014. "Berghain: The Secretive, Sex-Fueled World of Techno's Coolest Club." *Rolling Stone*, Feb. 6. http://www.rollingstone.com/music/news/berghain-the-secretive-sex-fueled-world-of-technos-coolest-club-20140206.

[45] Although residents of both cities often *visit* the other, moving from the U.S. to Germany for more than 90 simultaneous days is a more difficult endeavor due to the visa terms of the Schengen Agreement.

[46] For more on EDM's "techno tourism" in Berlin, see the work of Luis-Manuel Garcia (2011, 2012).

Betahaus is a coworking space in Kreuzberg, existing on an unassuming side street just past the chaos of the Kottbusser Tor U-Bahn station, edging onto Moritzplatz. It serves as a hub for the connection of technology and creativity that reflects today's largely international, English-speaking crowd of young, educated, tech-savvy Berliners. Coworking spaces have recently taken off in Berlin as a way to escape the constraints of the traditional office space while also avoiding the isolation of working from home. Many similar spaces have begun to emerge throughout Berlin, such as Agora, in Neukölln, and Supermarkt, in Prenzlauer Berg; Betahaus, however, is the largest and longest-running of these spaces, with a packed events calendar and a community of about 200 "coworkers, startups, artists and other makers."[47] The term "coworking spaces" has mostly replaced the former term "hackerspaces" there, which carries a slightly different connotation (to which I will return later in this chapter) and appear more commonly in other cities.[48]

In addition to various configurations of desks throughout its large multi-story warehouse, Betahaus includes a café, private conference rooms, spaces to host events, and a "FabLab" called Open Design City ("fab" as in fabrication, implying a large workshop space containing hand tools for electronics, woodworking, and similar

[47] http://betahaus.de/community

[48] One famously designated hackerspace in Berlin is c-base, a computer-oriented site established in the Mitte neighborhood in 1995. It is considered the first of its kind and has inspired countless subsequent hackerspaces around the world. Notably, the Pirate Party Germany was established at c-base in 2006. In New York, the more recently founded NYC Resistor is perhaps the most prominent hackerspace, crediting Germany's Chaos Computer Club as its inspiration. NYC Resistor holds a wide variety of classes and events, from sound to robotics to laser cutting.

Figure 3. The exterior of Betahaus blends into an unassuming office park, May 2013

projects).[49] The tools in Open Design City may be rented for personal use, following a training session; the center also offers workshops on perennially popular topics such as

[49] Although Berlin is at the forefront, one learns of a growing European scene for makerspaces, coworking spaces, and FabLabs, with Paris as another up-and-coming site. On his visit to various Parisian FabLabs, *Make* blogger Dale Dougherty learned that the people opening these spaces are navigating "'the relationship between being a business and being an artisan.'" On the use of the term FabLab here, Dougherty writes, "For the most part, the people managing and using these spaces don't see an important distinction between Fab Labs, hackerspaces and makerspaces, using the names somewhat interchangeably. That said, I've run across a few people who have very strong feelings that one is substantially different from the other. We'll leave that argument to others. What's important to me is to see these different spaces, how they foster making, and help build community." He notes that Brazilians have more readily embraced hackerspaces, while the French prefer FabLabs due to negative associations of criminality with hacking. http://blog.makezine.com/2013/06/12/a-faire-french-fab-labs.

3D printing and Arduino, as well as hosting a weekly social DIY gathering called Baustelmontag. *Baustel* is used here as a portmonteau of the words *bauen*, to build, and *basteln*, to tinker. The group behind this event defines *bausteln* as "*kreativ selbst etwas erschaffen*" [create something creative yourself] and states their motto as "*Demokratisierung des Produktionswissens*" [the democratization of knowledge production].[50] Thus, although other coworking spaces might appeal only to computer scientists and web designers who simply need office materials, Betahaus actively pursues associations between the business, design, digital media, and physical construction of artistic projects.

Betahaus provides an entry point to the social network of creative technologists with an interest in the arts. Its members are also typically in communication with the larger start-up and cultural scenes in Berlin. For instance, in June 2013, I interviewed Stefania Druga, a new Betahaus member and "global team lead" for the start-up HacKidemia. We discussed her goals for the company and their most recent event, a Music Hackathon for kids that was produced with the help of SoundCloud, held jointly in Berlin and Sofia, Bulgaria on June 1 to tie in with International Children's Day. A former Google employee from Romania, Druga's projects span multiple countries, but she was drawn to Berlin as a home base by its reputation as a hub for technology and the arts.

HacKidemia is "a mobile invention lab that enables future changemakers to access and create a hands-on STEAM education that will enable them to solve [specific] challenges by developing and testing creative solutions and physical artifacts."[51] In other

[50] http://bausteln.de

[51] http://www.hackidemia.com/mission

words, the team runs workshops that introduce children—and by association, their friends and families—to various technical skills in the hope that they will eventually choose careers in science and technology-related fields directed towards fostering social engagement and problem-solving. The acronym STEM (Science, Technology, Engineering, and Math) that is often used to describe a cluster of scientific career fields has evolved into the related term STEAM in recent years, adding room for the "A" in Arts. Druga hopes to reinforce this new career and educational cluster by increasing access to technology at a young age, before children have a chance to fall behind in science education. She said that by focusing on "play" and "imagination," HacKidemia is able to get through to children in ways that traditional education neglects.

For the Music Hackathon, Druga mined a variety of local resources: gathering and storing materials at Betahaus, tapping employees of SoundCloud to lead mini-workshops, and hosting the event at the venue/coworking space Supermarkt after bad weather forced them to abandon an outdoor location at nearby Mauerpark. Projects included building musical teeter-totters, turning fruit into instruments, and recycling old materials into musical hats. Participants were also asked to envision the music of the future and what technologies they could use to create it.

A featured technology tool was the MaKey MaKey, a recent invention from the creators of Drawdio (a pencil that uses graphite to conduct electricity and turns drawings into sound) that is frequently taught in workshop settings and is available online through DIY/maker supply sites.[52] MaKey MaKey was incubated in the MIT Media Lab's[53]

[52] Popular online supply sites for electronics components, DIY kits, and tools include the New York-based Adafruit and *Make*'s online store, Makershed. The most common brick-and-mortar stores during my fieldwork were RadioShack, in the U.S., and Conrad, in

"Lifelong Kindergarten" program as a way to "turn everyday objects into touchpads and combine them with the internet" via a small circuit board, a USB cable, and alligator clips that can be connected to any object capable of conducting a small amount of electricity: "Plants, Coins, Your Grandma, Silverware, Anything that is Wet, Most Foods, Cats and Dogs, Aluminum Foil, Rain, and hundreds more...."[54] Druga sees this kit as an essential and forward-thinking tool for making technology accessible and affordable for children (and adult beginners), and the coverage on relevant maker/hacker/music technology websites appears to fall in line with this prediction so far.

Druga went on to explain that although HacKidemia does not always include music in its workshops, music is the most successful and "universal" method that their team has encountered as a gateway for introducing participants to technical skills, since

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Berlin, but both charge higher prices than online suppliers. It is worth noting that RadioShack, especially, sought to capitalize on the Maker Movement's popularity by stocking products and targeting ads that would appeal to Makers. Additionally, New Yorkers can count on used electronic parts resellers on Canal Street; these shops often sell "junk," such as discarded speakers, that can be scavenged for electronic components or repurposed for new projects (see chapter 4).

[53] The MIT Media Lab contains a graduate program popular with many DIY music technologists. "High-Low Tech" and "Opera of the Future" are examples of "research groups" available for students interested in DIY music technology. A similar program in aim, called Interactive Telecommunications (ITP), exists at New York University; students and faculty at both locations are very much in conversation with each other and involved with the Maker scene at large. As of 2014, at least one of my interlocutors has attended a program at Parsons, the New School for Design, that he described as similar to ITP. Berlin's closest related program is in Sound Studies at the Universität der Künste, but dialog appears to be limited with international Makers living in Berlin as well as with the aforementioned U.S. programs. The European program most often cited by Makers and the broader DIY music technology network is Amsterdam's STEIM (Studio for Electro-Instrumental Music), an independent organization that offers a renowned graduate degree in Instruments and Interfaces, in affiliation with the Institute of Sonology at the Royal Conservatory of the Hague.

[54] http://web.media.mit.edu/~ericr/makeymakey

children find those activities more entertaining. When I asked whether she identified with the DIY ethos of experimental music scenes, she indicated that she considered tinkering for predominantly artistic ends to be self-interested and a counterproductive use of one's efforts. This point highlighted a specific tension between what I find are two categories of DIY music technology participants: those who foreground music, sound, or noise as the ultimate goal and those who foreground the development of technical skills. Consider this minor yet revealing part of HacKidemia's mission statement: "Tech companies will be able to: Identify and access market opportunities for educational applications and classroom integration of new products."[55] In the eyes of Druga and HacKidemia's partner tech companies, what is music *for*? I contend that, when approached from this angle, music is at once revered for its power to entice potential workers and consumers who might otherwise be uninterested in science and technology, while also being devalued as a worthwhile end result in its own right. Here, music is useful only if it teaches productive skills; on the spectrum from idle pastime to hobby to work, it is best if one strives for the latter. Druga's perspective is not "wrong"; in fact, given the economic climate following the 2008 recession, bettering oneself for the sake of employment is paramount for many. However, this instrumentalization of the arts aligns with broader trends in the Maker Movement that can serve to sell Makers short. Overreliance on the marketability of technical skills neglects a core tenet of the DIY ethos: to democratize the means of production towards the ends of enabling human creativity and community to flourish.

[55] http://www.hackidemia.com/mission

George Yúdice critiques the instrumentalization of culture as a "resource," arguing that "the role of culture has expanded in an unprecedented way into the political and economic at the same time that conventional notions of culture largely have been emptied out" (2003, 9). In contrast to the Frankfurt School of social theory, who believed that mass media devalued art and culture but left room for aficionados to transcend these new barriers to understanding, Yúdice writes, "Today it is nearly impossible to find public statements that do not recruit instrumentalized art and culture, whether to better social conditions…or to spur economic growth…." (11). My observations among the Maker Movement and related social phenomena, such as hackerspaces and coworking spaces, support this claim. Moreover, as funding for music education in public schools is increasingly demolished, even nonprofit music organizations created to counteract these budget cuts are obliged to "prove" the usefulness of music in order to justify their existence.[56]

[56] I credit Emily Dolan with bringing the term "instrumentality" to my attention. In this chapter, I intentionally juxtapose instrumentality, instrumental, and instrument in order to question: What kinds of "values" are embedded in musical instruments? (Alperson 2008 sketches some "instrumental values" from a philosophical standpoint but defers to ethnomusicologists and others to flesh these out.) In what ways do musical instruments function similarly to, for instance, instruments of science (Tresch and Dolan 2013)? How are music and sound instrumentalized for other means (Yúdice 2003)? Can instrumentality be synonymous with utility? In her research on the Field Band Foundation in South Africa, Laryssa Whittaker (2014) finds similar instances of music's utilitarian value for shaping young, productive workers with opportune "life skills," which she attributes to a complex history of neoliberal policies. A notable contrast is found in girls' rock camps in the U.S., which tend to instrumentalize music based on personal development rather than monetary value or technological skills. According to the Girls Rock Camp Alliance, the camps are intended to "help girls build self-esteem and find their voices through unique programming that combines music education and performance, empowerment and social justice workshops, positive role models, and collaboration and leadership skill building" (http://girlsrockcampalliance.org). Although these characteristics are perhaps "softer" forms of the use-value of music, this shift in tone from HacKidemia's references to "market opportunities," "companies," and

The activities surrounding Betahaus and its network of participants show the emphasis on acquiring technical skills over encouraging musical creativity for a segment of my interlocutors. Next, the following examples question the utilitarian value of music less explicitly, yet they retain a focus on products and environments that engender technical education.

"Circuits in Seconds": Gamifying Sound and Electronics with littleBits

HacKidemia is not the only educational start-up endeavoring to teach children as well as adults to hone their technical skills. As opposed to organizing workshops and events, New York's littleBits represents a recent foray into building physical toys. Founded by MIT MediaLab graduate Ayah Bdeir in 2011, littleBits comprise tiny circuit boards that snap together with magnets to create various modular projects—analogous to LEGOs for electronics. As a result, the process circumvents the need to use a soldering iron, identify electronic components, or wire together prototypes—foundational skills for DIY music technology (considered essential by many participants) that can also serve as barriers to entry for those new to electronics. The goal of littleBits is to erase this barrier and to render creative electronic projects more accessible to the general public. The company "aims to move electronics...from the hands of experts, to those of artists, makers, students and designers."[57] The creators consider littleBits a form of "open source hardware" (a variation on the term "open source software" that signifies the design is

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"products" is striking. I am tempted to see a gendered dimension at play here, although this is complicated by the fact that the founders of both HacKidemia and littleBits are women.

[57] http://littlebits.cc/about

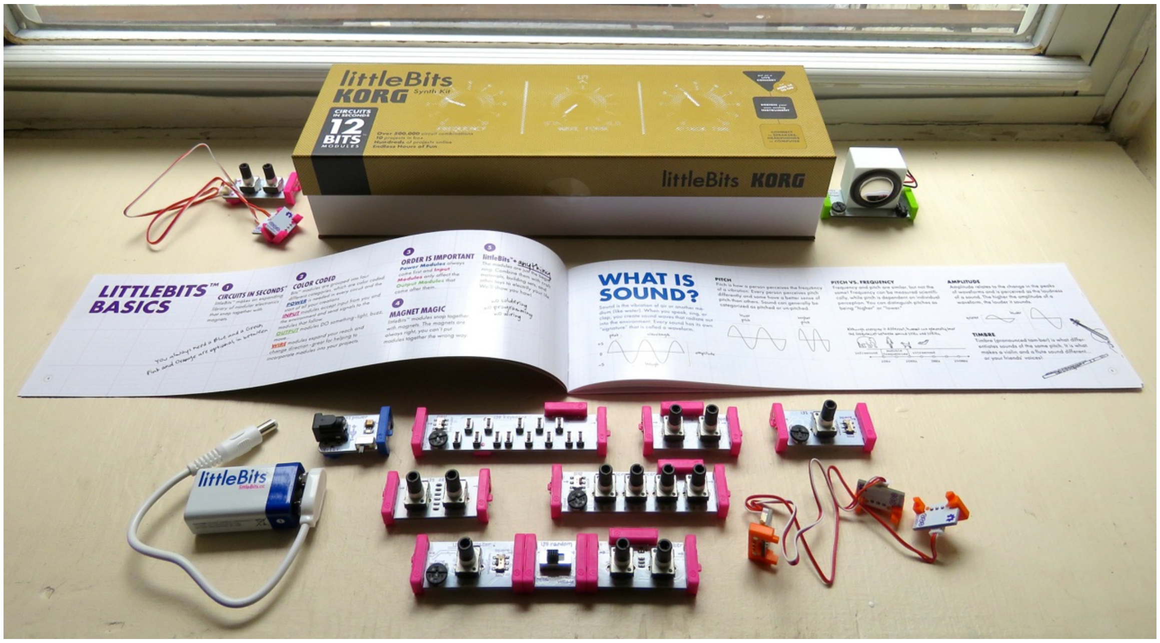

Figure 4. littleBits/Korg Synth Kit

legally and physically available for free public experimentation) because they continually update an online library of designs for their modules and allow these designs to be freely circulated.

We can clearly see how the company views itself and its consumer base through its recent collaborations to create educational project kits. These kits combine standard littleBits components with special limited-edition ones, such as sequencers and microcontrollers, as well as customized lesson booklets. For instance, littleBits has most recently partnered with the open-source microcontroller Arduino, for which they created a special Arduino module and an Arduino Starter Bundle kit.[58] As with an increasing number of Maker endeavors, littleBits, too, has partnered with NASA; their Space Kit

[58] The Arduino is discussed further in the next section. This particular littleBits kit is part of the Arduino at Heart program, "designed for makers and companies wanting to make their products easily recognizable as based on the Arduino technology" (arduino.cc/en/ArduinoAtHeart/products).

advertises NASA lesson plans and STEAM educational activities, including sound-related ones. (In one example, because NASA "uses electromagnetic waves to communicate with satellites orbiting Earth," a lesson in the accompanying booklet shows how to transmit music wirelessly: sound waves from a digital audio input such as an mp3 player are converted into light wave pulses via LEDs, then converted back again through a speaker.) In a third collaboration, littleBits partnered with the Korg Corporation for electronic musical instruments to create a Synth Kit. Peter Kirn, a New York-and-Berlin-based writer for the website Create Digital Music, writes, "I do think this is a big deal–for DIY, for open source hardware, and for the love of sound" (2013).[59] He continues:

> littleBits, by laying bare the guts of a synthesizer and letting even kids put it back together again, is a beautiful embodiment of the idea of DIY sound. The fact that its circuits and firmware will soon be open source makes that doubly true. Think of it not just as one solution to that desire to make, but a spark. As the whole landscape of experimentation with sound, the love of noise, continues to widen, the idea of musical invention as play is about to get a whole lot more popular. (ibid.)

Meanwhile, blogger Drew Diver of the New York-based *Motherboard* online magazine comments:

> Sure, you can buy a keyboard to attach to your computer and sit through assigning knobs and load up patches to expand upon, but this kills a little of the uniqueness and learning experience in the process of sound creation. There is no uncertainty of "what will happen if I connect this to this?" and physically move the units around. One should be immersed in the instrument, not the computer. (2013)[60]

Toys like littleBits have also come under fire as a way of "gamifying" education. Gamification's simplest definition is "the use of game design elements in non-game

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[59] http://createdigitalmusic.com/2013/11/littlebits-synth-kit-first-hands-sound-like-reviews-videos

[60] http://motherboard.vice.com/blog/the-synth-anyone-can-build

contexts" (Deterding et al. 2013). It entails taking an educational skill-building activity that would ordinarily feel tedious and laborious, instead entertaining the learner with "challenges" or "levels" that can be completed and celebrated with a congratulatory message, virtual certificate, or simply an incentive to move up to the next level. Gamification also often provides visual and sonic feedback to make the material more "fun," such as bright, candy-colored pieces/tools and sounds emitted when a project is complete. The practice has been heavily critiqued where it relates to massive open online courses (MOOCs) and now extends into language-learning websites (e.g., LiveMocha, in which one can earn points for completing language exercises, helping others with pronunciation, etc., which can then be used to "unlock" harder levels or even free materials), websites to learn computer coding (e.g., Codecademy, an immensely popular tutorial-based website in which users receive encouragement and credit for modules completed), and interactive games (e.g., *Guitar Hero* and *Rock Band*, which involve learning to play "fake" instruments suitable for digital gameplay but not necessarily applicable to standard musical performance practice).[61]

In situating games as subjects of musicological study, Roger Moseley (2013) extends the term *ludomusicology* to include but also look beyond video games at further aspects of play and of "playful engagement" with music. When players pick up an instrument-shaped controller in a digital game such as *Guitar Hero*, they not only mimic performance on the original instruments but also participate in a practice of "recreation" with dual meanings. Moseley explains that "as well as connoting the pleasure and

[61] See chapter 2 for the iPad's use in teaching scientific concepts through popular music, most notably through Björk's *Biophilia* album, its accompanying experimental instruments, and its series of interactive iPad applications.

entertainment derived from playful activity, [recreation] connotes the games' reproductive aspects and the extent to which they inspire players both to play according to the rules and to create anew via disruptive play, hacking, and the modification (or "modding") of both software and hardware" (284). Furthermore, Moseley frames this individual and collective creativity enacted through hacking and modification[62] as a "punk-rock-inspired do-it-yourself ethos…contributing both to the content and to the counter-cultural image" of the game (293).

Reflecting the account of "productive leisure" outlined in Stephen Gelber's history of hobbyism (see introductory chapter), Moseley, too, finds that play circumvents the work/leisure binary; drawing on such varied sources as Max Weber, Beethoven, and Plato, he cites numerous examples of thinking about play in ways that span both categories. Most pertinently, he notes the "pursuit and unification of aesthetics, happiness, and moral perfection" that occurred with Friedrich Schiller's notion of the *Spielbetrieb*, or "play instinct" (286). According to Schiller, "Man plays only when he is in the full sense of the word a man, and *he is only wholly Man when he is playing"* ([2014] 1795: 63). Yet Schiller also begets issues of use versus beauty, as he pairs play with the latter, while lamenting the reign of "utility" and "necessity" (21). This exaltation of *play as ethos* assists our understanding ethical labor for many Makers and DIY music technologists, but my interlocutors maintain a more ambivalent relationship to play as aesthetic; rather, we might say the ethos is steeped in a *technoaesthetic* that blends work and play through the engagement with technology (see introduction and chapter 4).

[62] Some examples include online communities that share game tips and "cheats," as well as players who devise methods of turning game controllers into functional MIDI instruments.

Meanwhile, ethnomusicologist Kiri Miller (2012) has studied the relationship between music and social participation in recent digital games and virtual performance experiences like *Guitar Hero* and YouTube music lessons. In questioning whether games can be considered "texts" analyzed in the tradition of twentieth-century literary theory, Miller is indebted to Jeff Todd Titon (1995). Titon sees events, artifacts, performances, and so forth as "folkloric texts," arguing that folklorists are equipped to attend to the instability of non-written texts, which have "an emergent, processual character, stressing the dialectic of innovation and tradition within community-based expressive culture, and the relations between performer and audience" (439). While Miller employs this expanded definition of texts specifically for games, I believe that the folkloric text also resonates with DIY music technology's emphasis on prototypes and vaguely directional, if circuitous flow. Titon stresses that the *inter*textuality of such texts is precisely why they are of folkloric interest, being that "there is no single authoritative text, but rather a folkloric text exists in multiple versions and variants, similar and therefore referencing one another..." (ibid.). The events, artifacts, and performances of DIY music technology relate to one another in this way. Looking at the similarities and differences of current experimental musical instruments, kits, and toys, intertextuality comes into play through the fluidity of designs, purposes, and educational skills they engender and reinforce.

Moreover, as Miller states, such "voluntary leisure activities" entail more than just entertainment: they require time, money, effort, and skills. She asks, "How do [music-oriented games] generate the affective experience that justifies those investments—that is, what makes them engaging, fun, satisfying, and meaningful? If 'playing along' is inherently conformist, might it also leave some space for creativity?"

(2012, 6). We might use similar evaluative criteria for toys like littleBits: by the logic of the Maker Movement and its related start-ups, education, personal development, collaborative activities, and creative designs are at stake. In order to ensure success, the toy must also be *fun*, so that users (or players) return to continually build on these potentials over time.[63]

Despite these goals to entice the general public to learn technical skills through play, its ratio of education-to-cost of littleBits is questionable. For instance, littleBits pieces are not always marked with terminology used in the electronics world: participants would not learn what a resistor is or how this component is used within a module, as when the module marked “light trigger” is actually triggered by a light-detecting photoresistor. Without the skills to solder and to wire up a prototype on a circuit board, one's chances of advancing to real-world electronic projects are currently limited. The Synth Kit’s accompanying instruction booklet juxtaposes snippets about the science of sound with phrases like “magnet magic.” I myself bought this kit—knowing that I could otherwise put that money towards a fully functional instrument—wondering if it would be a good educational “investment.” After testing the kit, I found it promising, beautifully designed, and, yes, *fun*. However, it felt like more of a jumping-off point to pique one’s interest *about* synthesizers rather than informative on its own terms. With its brightly-colored modules, slick packaging, and the instant gratification of building “circuits in seconds” (the littleBits motto), this education-oriented invention certainly meets criteria

[63] Chris Anderson (2012) also points to the importance of community for Maker businesses. By his logic, having an open-source product is both good for society and good for business because it enables a community to form organically to share and improve upon designs. Thus, it encourages repeat customers who have something at stake in the product.

for "gamification"; its ability to affect the goals espoused by its inventors, however, remains to be seen. Additionally, the high price-point of littleBits effectively renders it *in*accessible to many: the Synth Kit runs for $159, and the least expensive kit, containing only 10 modules, is $99. As a new start-up company, littleBits still has time to attend to its critics' complaints and to expand in many facets; however, it exemplifies the difficulty of combining a business model with the goals of the Maker Movement and the DIY ethos more broadly. The future of DIY music technology might well exist in magnetic circuits, but that future is not yet affordable to the broader public that Makers purport to want to reach.[64]

***Bastl* and the Allure of DIY Creativity**

In March 2013, I found myself at a workshop with Standuino at Neue Heimat, an arts space, or a bar, or perhaps just someone's living room (in Berlin, it is often hard to tell the difference). Standuino is a small business for handmade electronic music and open-source hardware started by two students from Brno, the second largest city in the Czech Republic. Václav Peloušek and Ondřej Merta travel throughout Europe in their spare time, providing workshops that introduce participants to their invented instruments and walking through the steps of how to build them. In this workshop, participants from various European countries (as is typical of these workshops, only one builder was German on that day) toiled through 10 hours of soldering to each build an instrument of choice from the Standuino shortlist of inventions.

[64] See the dissertation's conclusion for a discussion of a surprising relationship between littleBits and experimental music.

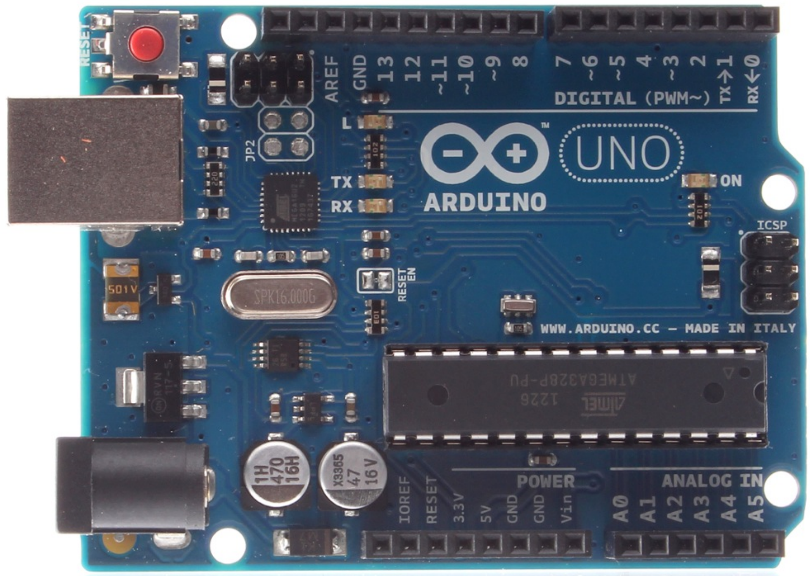

Figure 5. Arduino Uno board, type used most during my fieldwork
(Image Creative Commons from Wikimedia Commons, by user "bomazi")

The driving force behind these instruments is the Standuino board. This is based on the Arduino, an inexpensive, user-friendly microcontroller board geared towards artists and hobbyists. The Arduino was designed in Italy in 2005 for the purpose of enabling students to experiment with low-cost electronics. It has since become a wildly popular device in the world of DIY electronics, and out of all technologies championed by the Maker Movement, the Arduino is the most central, appearing constantly in suggested projects, in online stores, and as the backbone of other start-up companies' products.

The Arduino's basic technology works as follows: a microcontroller acts as a tiny computer chip within a circuit board that one can program to complete a given task, and it will remember these directions until they are altered. According to its website, the

"Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators."[65] Electronic components like LEDs or resistors are stuck into the slots on the circuit board, and then computer code is uploaded from the Arduino website forums (or users may write their own code) to program it complete a task, such as making the LED blink or a motor move. Since the device is open source, people are free to develop it however they like, so offshoot boards have begun to appear. The Standuino is one such board that allows for more components and customization for sonic purposes, since the original was not necessarily designed with music in mind.

The word "Standuino" is meant to connect the Arduino name to Peloušek and Merta's larger goal of introducing the world to *bastl*, which they argue is a unique, localized form of DIY in the Czech Republic. "There are two layers of the [word] 'bastl' in Czech," they clarify in an interview for a German blog. "In German of course we have the word 'basteln.' But in Czech if you say 'bastl' it really means DIY electronics. Of course it's adapted from German but it comes from the communist times and is still a slang word. It's not a proper word, but many people know it."[66] Through their university studies, Peloušek and Merta encountered the lives and work of earlier Czech pioneers in DIY electronics and media art like Standa Filip (the "Stan" in Standuino), whose creative drive despite a lifetime of obscurity as a musician and inventor has influenced the pair immensely. When I later met Peloušek for a follow-up conversation at a Czech bar and community center in Vienna, where he has recently moved to continue his studies, he

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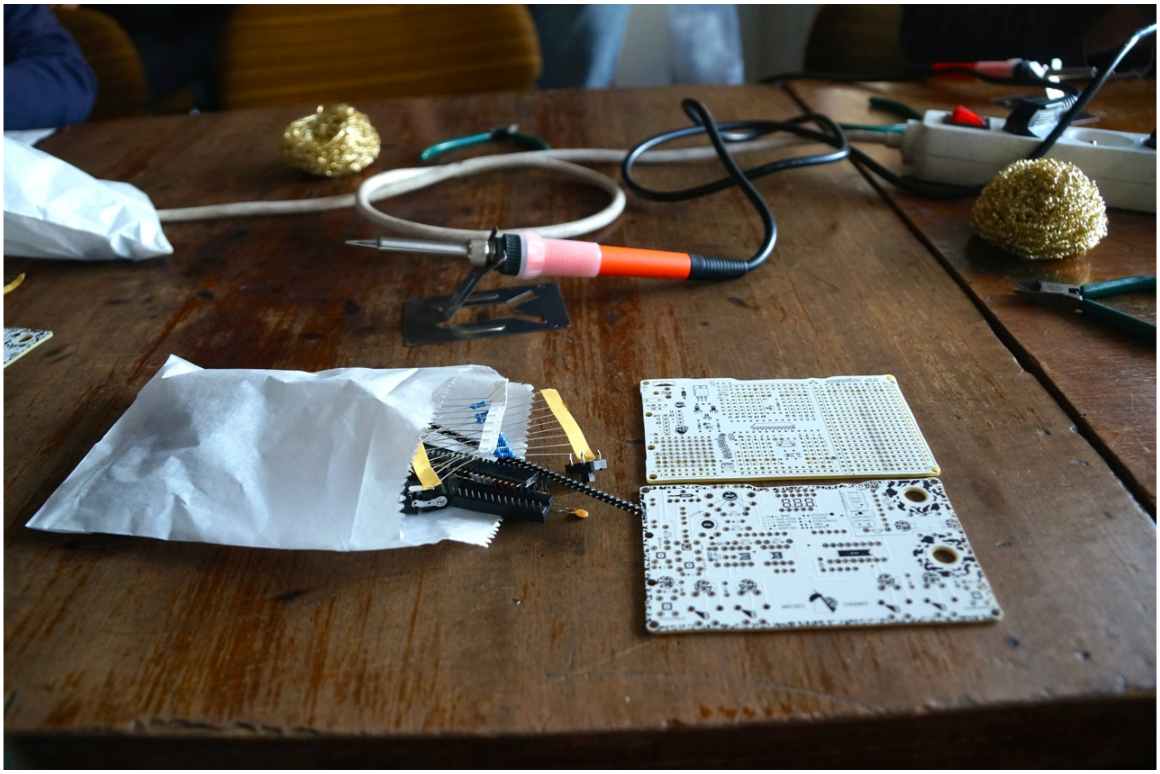
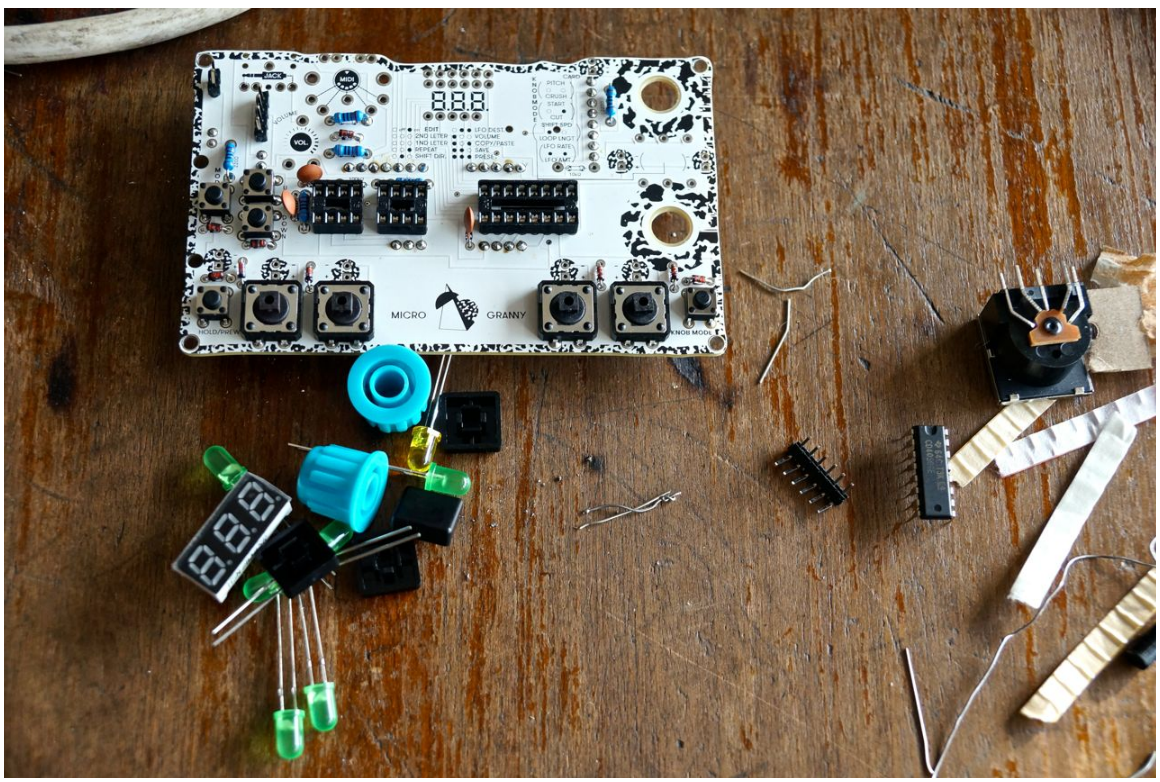
65 www.arduino.cc

66 Excerpted from a 2013 interview, "Vom Basteln und Bastl: Das Bastl Orchestra." http://deadidiot.com/blog/2013/10/vom-basteln-und-bastl-das-standuino-orchestra.





Figures 6 and 7. Building the MicroGranny:
Standuino boards and tools,
Workshop at Neue Heimat, March 2013

indicated that the Standuino crew was in the process of filming and translating a series of interviews with Filip as part of an initial push towards their larger goal of preserving the cultural history of DIY culture in postcommunist countries of Eastern and Central Europe. According to the Standuino website (which reads a bit roughly, since they have translated it from Czech), "This region was incredibly rich in this kind of folk creativity during the communist times. Some of the people are still alive, but because of no more need in creating custom products, most of the creations are being thrown away." In person, they told me that behind the Iron Curtain, parts were not easy to buy, so people experimented as far as they could go with existing and repurposed parts. If people needed something, they built it themselves. Today, they say that parts stores in Brno have exceedingly long lines out the door, but that the crowd is mostly elderly, since young people more commonly purchase ready-made consumer equipment. Peloušek and Merta hope to connect this history with the broader hacker and Maker Movement sweeping the public consciousness, in order to encourage a younger generation to build and to tinker—not only as a form of memory politics, but also to instigate unique contributions to music and society.

Despite my attempts at further clarification, however, two central questions linger. I was unable to confirm: 1) exactly *how bastl* is a specifically *local* type of creativity—that is to say, one distinct from other places; and 2) what was necessarily *more* "creative" about tinkering with electronics in this location. While it is a truism that necessity breeds invention, in any location where certain equipment is desired yet inaccessible to the general public, would similar actions of tinkering take place *across* those locales? Although I cannot speak directly for the Brno, examples of DIY creativity in the former German Democratic Republic and other Soviet territories might offer clues about this local, or at least regional, diversity of tinkering.[67] Citing the nature of electroacoustic improvisation, Tatjana Böhme-Mehner writes:

> If there is something that was characteristic of everyday culture in the GDR, it was a certain resourcefulness in manoeuvring on the edge of legality. This stemmed from a combination of a social necessity to improvise, and a natural sense of communicative perceptiveness resulting from a need for social survival. The popular German saying 'necessity is the mother of invention' applied in many ways, especially to the mentality of GDR citizens, and led to an absolutely unique creativity in everyday life. (2011a, 61)[68]

Meanwhile, in chronicling the East Berlin DIY scene, Susanne Binnas described in 1991:

> At the beginning there was the game of getting instruments, which still managed to find their way under intense conditions (at enormously overpriced, foreign currency black market prices) to the tinkers and DIY handymen. This situation was not in any way comparable with the usual possibilities available internationally. The revolution in technological know-how in the field of music electronics never actually made it to the GDR. Yet this absence in particular gave birth to an idiosyncratic creativity. The technical and technological possibilities of the available materials were exhausted. Most of them entered an artistic no-man's-land in doing so….[69]

Towards the second question, how can one *measure* innovation and creativity in music technology? At this juncture, making value judgments on creativity has not been my goal, so let me reframe this issue: Why do DIY music technologists crave uniqueness and

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[67] Of course, in numerous sites beyond the context of the cosmopolitan West, tinkering as necessity can emerge as way of life (e.g., Greene and Porcello 2004; Steingo 2015). See also chapter 3 on repurposing materials.

[68] Elsewhere in the same volume, Böhme-Mehner ties this to GDR composers' "different concept of self" that was more inclined to keep the listener in mind than in the West (2011, 5).

[69] Reprinted as Susanne Binnas-Preisendörfer in 2012, "In a Musical No Man's Land: Unheard-of Productions on the Fringes of the Rock Culture." This piece was originally written for the magazine *Positionen* but is now at the website *Sound Exchange*. http://www.soundexchange.eu/#germany_en?id=51&parID=2.

creativity through tinkering not only when they are *forced* to (due to the physical absence of resources or knowledge), but also after these barriers are removed?

In order to probe this question, I wish first to reconsider some basic definitions. Let us begin with my premise from earlier in this dissertation that DIY music technology can be seen as a type of "folk technology" tied to an expanded conception of "hacking." Recalling Jeff Todd Titon's folkorist (inter)textuality, the idea of "folk technology" came to my attention very gradually, as I have now heard multiple instances of my interlocutors referencing the so-called "folk" aspects of their practice. In New York, a former curator of the annual circuit bending festival, Phillip Stearns, used the term to describe an inspiration for his projects. And the founder of circuit bending, Reed Ghazala, published a scholarly article that referred to the phenomenon as "The Folk Music of Chance Electronics" (2004). In Berlin, workshop leader Derek Holzer said he had encountered the term in Portland and that it continued to influence his instrument building process and aesthetic. And, of course, the Standuino inventors repeatedly emphasized the "folk" characteristics behind their work.

Within scholarly literature, I have found folk technology to be an underdeveloped concept that typically describes indigenous expert knowledge under the radar of the Western notion of cutting-edge "technology" as synonymous with "high-tech." For instance, Dwight Read and Clifford Behrens (1989) provide a theoretical basis for combining "folk knowledge" with "expert systems" in their research on cognitive anthropology. Meanwhile, Paul Manning and Ann Uplisashvili (2007) analyze it in terms of local beer production, Louanna Furbee (1989) addresses its role in soil classification technologies, and archaeologists Marcia-Anne Dobres and Christopher R. Hoffman

(1994) consider the enduring value of prehistoric technologies. I find that DIY music technology functions as a bottom-up approach to innovation; yet, as Derek Holzer noted in the introductory chapter, its materials impose their own kind of "top-down" framework of knowledge (e.g., "This is how we are supposed to use a circuit board…"). DIY music technology derives from both the physical parameters of its materials and in culturally established ways of using them, resulting in a vernacular practice of knowledge formation that is also laced with existing systems of expert knowledge. As I will reemphasize later, is at once forward-thinking and self-consciously antiquated in its search for new sounds, meanings, and re-interpretations.

Meanwhile, "hacking" is a major theme among my interlocutors that refers to the rewiring of electronic circuits for purposes unintended by their original creators—or, more broadly, the reassertion of agency into standardized formal chains of production. The term has mostly been associated with computer code-cracking and sometimes criminal activity over the years. The *New Hacker's Dictionary*, released in 2000 as "a comprehensive compendium of hacker slang illuminating many aspects of hackish tradition, folklore, and humor," includes such definitions for a "hacker" as:

> [Originally, someone who makes furniture with an axe] 1. A person who enjoys exploring the details of programmable systems and how to stretch their capabilities, as opposed to most users, who prefer to learn only the minimum necessary. […] 6. An expert or enthusiast of any kind. One might be an astronomy hacker, for example. [And] 7. One who enjoys the intellectual challenge of creatively overcoming or circumventing limitations.[70]

[70] A few versions of *The New Hacker's Dictionary* were released by MIT Press in the 1990s, but editor Eric Raymond continued to update the terms online: http://www.proselex.net/documents/the%20new%20hacker's%20dictionary.pdf.

There are many ways to phrase this idea besides just “hacking”: building, inventing, tinkering, modifying, circuit bending, and so forth. But the word “hacking” has become so pervasive lately that it is the most common term I hear in use. It often implies an ideological component but is sometimes just a way to indicate that one has found a hidden trick to something previously considered unalterable or uncontrollable. A related term is simply “making,” as seen in the recently booming Maker Movement and its World Maker Faire in this chapter's introduction. When dealing with DIY projects, I would venture that “making” could also be used to describe building something from scratch, whereas “hacking” involves repurposing electronics or creating hybrid instruments from other materials.

The ideological component, though ignored by some participants, retains an important lineage that I do not believe is entirely separable from the act of hacking. As acknowledged in *The New Hacker’s Dictionary*, there is a “hacker ethic,” in which hacking positions itself as a form of resistance, with an implied belief in open source hardware and software, Creative Commons as a way to circumvent traditional copyright laws, and the free flow of information. The DIY movement can even be “militant,” as in Polish-born, Brooklyn-based media artist Marcin Ramocki’s manifesto, called “DIY: The Militant Embrace of Technology” (2009). Ramocki uses a Marxist critique—the alienation of consumers from the fruits of their labor—to analyze what he sees as a new wave of artistic practice centered on technology and the DIY ethos, or, as he puts it, “certain cultural practices involving the subversion of consumer technology” (1). He views these artists as hackers, as “inventors and generators of new value and the necessary pioneers of constantly revolutionizing means of production” (3). He sees

> a militant intention and strategy to reveal the aspects of technology which we take for granted. […] Figuring out what is inside the black box (and why it was made) is becoming the official duty of artistic communities. […] We mess with electronics because we identify it as a source of meaning for our generation, a way of re-connecting with our surrounding reality mostly composed of code and technology. (6)

Finally, Ramocki believes this is "a very specific, tactical approach of returning technological knowledge where it belongs: in human lives" (ibid.). Although I do not imply that *all* DIY music technologists are motivated by resistance rather than, perhaps, curiosity and leisure, this element nonetheless remains pervasive.

I believe that these various interpretations of the act of DIY music technology—whether folk technology, hacking, making, or basteln—lead to a similar conclusion about the transformational process of "becoming" when tinkering with sounds and electronics. The DIY ethos reclaims technology from mainstream production, creating a different sense of the self than would be inherited from a static consumer position. As media formats become increasingly interactive all across the audiovisual spectrum, the present is a crucial time to observe how the relationship between technology, creativity, and the self is in flux.[71] Not everyone is on a political mission here, but DIY music technologists' understanding of sound, self, and society cannot emerge unscathed once they have made the commitment to open the black box. Thus, building is not merely building; it is democratizing knowledge production about sound and technology.

In late 2013, Standuino planned to transition into a new DIY small business called Bastl Instruments and to create a Bastl Orchestra. Meanwhile, the prior formation of the Standuino group produced one last instrument, the 2π whitenoise synthesizer, before

[71] See, for example, Lessig 2008, 2004; Benkler 2006; Hertz and Parikka 2012.

shifting focus to "an artistic project aiming to bring up stories from the history and show the poetry of [C]zechoslovakian DIY of the communist era."[72] As of mid-2014, Bastl Instruments is up and running, and its mission is clear: to produce handmade musical instruments that move beyond the prototype phase, providing local employment opportunities and cultural recognition for Czech inventors in the process. For Peloušek and Merta, homing in on production does not mean abandoning their DIY ethos and their belief in instrument-building workshops as fostering a sense of community, however; the project's core identity remains visible on the new website:

> We are musicians passionate about making innovative sonic environments and social situations. That is why we make our instrument the way we do them. We want them to be sounding unique and big, we want them to be diy, modifiable and therefore initiators of social interactions – both online and offline. That is why we love to make workshops! Meet people build stuff, gather ideas, modify the instruments and play them together.[73]

By pursuing "DIY as an unofficial history,"[74] they continue to argue that a "bastl generation," born in the 1960s and most active in the 1980s left an enduring mark on local culture: "…still today you can meet this generation and their hacker souls in many aspects of everyday life in czech republic [sic]."[75] Furthermore, note their language: "innovative," "unique," "hacker souls," and so forth; their descriptions of *bastl* as a source of local pride and their desire for both independence and community intersect directly with the language and values of DIY music technology on a much broader scale.

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[72] http://www.bastl-instruments.com/about

[73] Ibid.

[74] From previously cited interview at http://deadidiot.com/blog/2013/10/vom-basteln-und-bastl-das-standuino-orchestra.

[75] http://www.bastl-instruments.com/about

The reference to "hacker souls," especially, signals a deep investment in connecting with a certain *kind* of person who values the pursuit of knowledge and opportunity for oneself and the surrounding environment. Peloušek and Merta believe that this pursuit has pervaded the Czech identity, while I view it as a transnational and transhistorical phenomenon, propelled most recently by Maker culture. In either case, Standuino and Bastl Instruments highlight the search for socially-conscious *potential* through creative tinkering—for participants to develop themselves, their skills, their communities, and secondarily, their financial standing—as a driving factor in DIY music technology.

Death of a Venue: The Growing Pains of DIY

> *At the end of the day we're still running a business, so we want to expand and make money, but really we feel like we're participating in something that's so much bigger – this maker culture movement. People are craving this tactile, self-efficient practice and we give them a place to do that, a place to learn and connect with other creatives.*
>
> – 3rd Ward founder, Jason Goodman[76]

Unlike Standuino's presently smooth transition from DIY hobbyism into business venture, another enterprise ostensibly for the benefit of a local Maker community has proved less scrupulous. On October 9, 2013, members of Brooklyn's 3rd Ward took to the Internet to express shock and outrage over the untimely closing of the influential arts space. 3rd Ward was founded in 2006 in a warehouse on the border of the Williamsburg and Bushwick neighborhoods to offer studio space for both hobbyist and professional artists and event space for a variety of arts-and-tech community gatherings, such as the

[76] Interview with Jenn Godbout, undated, circa 2012: http://99u.com/articles/7197/jason-goodman-on-maker-culture-hands-on-learning-the-diy-movement#comment-582749611

monthly Drink & Draw and exhibitions of audiovisual experiments. One event in particular that underscored their commitment to the DIY community was the annual Last Supper, an interactive gallery exhibition-meets-block party with an emphasis on consumption and sustainable local practices. The call for participants in September 2010 was advertised in the following terms:

> This year's curatorial theme, "Self-Made", will explore the creative individual as a self-made person and provocateur of social change. Using an experimental, multi-sensory, collaborative approach, the artwork is intended to critique the way we produce the goods and services that define our generation, the way we consume media, products and our environment, and the way open dialog, DIY and technology promotes self-made identity prototypes.[77]

Perhaps the most important contribution of 3rd Ward was its enormous range of DIY classes. One could become an annual member or sign up for a one-off class on a topic from woodworking to moccasin-making to electric guitar "rescue." Initially proposed as a "marketing tool" to draw members into the co-working atmosphere of the space at large, founder Jason Goodman soon realized the demand for imaginative, high-quality, non-degree classes in the neighborhood. Although considered by many participants to be expensive compared to the offerings at smaller arts spaces, 3rd Ward's classes were known for their consistent quality and for paying instructors relatively well.[78]

3rd Ward remained a giant in a neighborhood packed with DIY venues until its closing: apartment-sized concert venue Shea Stadium and gallery space 319 Scholes, once a host of the annual circuit bending festival, Bent Fest, resided just down the street.

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[77] https://www.3rdward.com/blog/2010/7/13/the-last-supper-accepting-art-for-the-september-salon-3rd-ward.html. I accessed 3rd Ward's website in 2013, but it is no longer active.

[78] As indicated to the author in conversations with New York-based interlocutors in summer 2012.

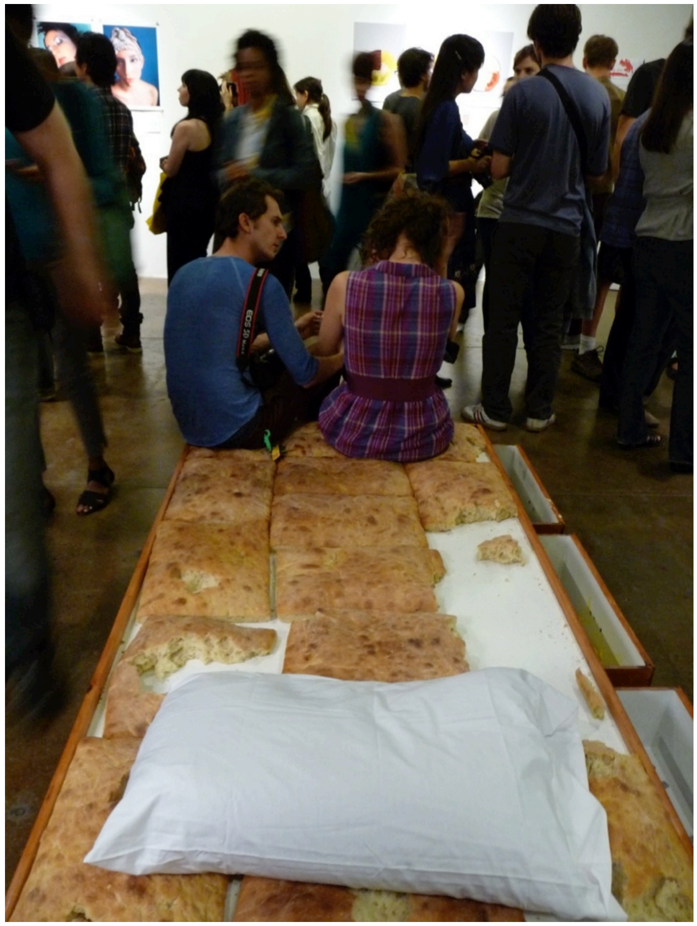

Figure 8. Crowd at the Last Supper, 3rd Ward, September 2010

But in September 2013, the venue clearly articulated aspirations that made its homegrown community members uneasy. The owners began a Kickstarter-style quest for "accredited investors" in search of $1.5 million to cover their deficits, largely attributed to the opening of an outpost in Philadelphia and a culinary partnership.[79] The company knew it was in trouble, yet it continued to accept payments for classes and annual memberships, even imploring members to purchase gift cards without mentioning the likelihood that the credit would never be honored.[80]

79 https://fundrise.com/pre-offering/3/view

80 https://3rdward.com/invest

In October of that year, 3rd Ward abruptly announced that classes and memberships were cancelled without refund—only credit for products in the online store were allowable. Meanwhile, the location shut its doors, the website fell inactive, and the owners seemed to disappear. (However, the New York news blog *Gothamist* did track down the owner's lavishly renovated "Montauk getaway," purchased with his 3rd Ward salary, to the further outrage of spurned customers.[81]) Once the perception arose that 3rd Ward was a for-profit educational business taking advantage of its community support, former members and instructors were quick to scorn its business model.[82] Blame was attributed to a range of ill-advised developments, from overspending on a new Philadelphia satellite building to pressuring instructors to promote their own classes or face inadequate compensation. One former member believes that "3rd Ward drove out artists for weekend hobbyists. It wasn't really about investing in the community after last year, just getting people to take classes."[83] The venue's previously active Facebook page, its main interface with the public, has not been updated since a farewell message on October 11, 2013, yet angry comments continue to trickle in, maintaining one of the few

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[81] Del Signore, John. 2013. "Inside 3rd Ward Owner's Sweet Waterfront Getaway in Montauk." *Gothamist*. http://gothamist.com/2013/10/10/inside_3rd_ward_owners_sweet_waterf.php.

[82] See a number of online articles confirming this view, investigated in the year following the closing: Mostafa Hedaya in 2013 at http://hyperallergic.com/88183/blessed-are-the-makers-the-rise-and-fall-of-3rd-ward; Robin Grearson in 2014 at http://www.culturalweekly.com/3rd-ward-community-collapse-cost; Phillip Pantuso in 2014 at http://www.bkmag.com/2014/10/02/3rd-ward-debt-allegedly-more-than-70000.

[83] Heddaya, Mostafa. 2013. "3rd Ward Suspends Operations, $1.5M Investory Operation Shut Down." *Hyperallergenic*. http://hyperallergic.com/87462/3rd-ward-suspends-operations-1-5m-investor-offering-shut-down.

Figure 9. Exterior of 3rd Ward, 195 Morgan Avenue, July 2012

public records of a vanished community: from "Refund the people!" to "Thieves!" to "Very sorry to everyone affected by this scammer." In efforts to preserve their sense of community, commentators have reposted 3rd Ward's deleted terms of service to encourage collective legal action and have offered assistance to fellow members whose workspaces were displaced by the closing.[84]

In a city still reeling from the economic and political greed and negligence challenged by Occupation Wall Street and other protests, those promised "a home for Brooklyn's burgeoning creative community of makers, designers, tinkerers, and

[84] https://www.facebook.com/3rdwardbrooklyn

thinkers"[85] now levied accusations of financial fraud and mismanagement towards one of their own. Labor went unpaid, materials went unbuilt, and seemingly well-laid plans went awry. Was 3rd Ward's fate purely an accident of ineptitude? Is the Maker Movement ultimately sustainable in the competitive business and artistic terrain of New York City? Regardless of the founder's intentions, the experience appears to have jaded the local Maker community. "They lost people's trust," one of my interlocutors laments. "I feel like maybe they ruined it for everyone else trying to do that because it was *so* poorly managed." Although other venues exist to pick up abandoned opportunities from 3rd Ward's base, these venues are typically either more specialized (such as the hackerspace NYC Resistor or the electronic arts center Harvestworks), offer only basic introductory classes without room for growth (such as the one-to-three day sessions at Brooklyn Brainery, on any number of subjects that only occasionally include the arts and technology), or are seen as disorganized. As of spring 2015, my questions for my New York interlocutors about 3rd Ward and its promise for creative community and education are still met with eye rolls and cynicism. Given the tepid reception of building newcomers Livestream—a technology startup that relocated the prior May from Manhattan, hoping to seize upon Bushwick's cultural capital[86]—it remains unclear to what extent New Yorkers will trust such ambitious endeavors in the future.

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[85] Ibid.

[86] Ryzik, Melena. 2013. "3rd Ward, Brooklyn Art and Design Space, To Close." *New York Times, ArtsBeat Blog*, Oct. 10. http://artsbeat.blogs.nytimes.com/2013/10/10/3rd-ward-brooklyn-art-and-design-space-to-close.

Conclusion

These four case studies showcase the tensions and limitations that arise when the DIY ethos, as channeled through the Maker Movement, is translated into real-world scenarios. As a generally self-reflexive group, Makers rarely shy away from theoretical discourses about labor, entrepreneurship, and the value of education; in practice, however, forming new models through which to simultaneously acquire technical skills and tools for creative expression is seldom a seamless task, especially when coupled with the desire to operate independently of corporate interests. In effect, it seems that the more one pushes for "progress," as envisioned in a utopian Maker Age, the more DIY seems to fold back in on itself: building a utopian "world of tomorrow"—in fact, even planning a single Maker Faire—requires capital and existing infrastructures more than some Makers might like to admit. In this pursuit, merging DIY with Disney (or Google, or DARPA) appears to have become the norm. But by considering the "folk technologies" embraced by Makers, we can also see opportunities for innovation on a modest scale. And while different Makers may value the arts to different degrees, in the realm of music, sound, and instruments, the resulting technologies and their educational transmission is opening avenues for experimentation. We may never know whether veterans of HacKidemia or 3rd Ward pursued significant musical endeavors, but Standuino and the littleBits Synth Kit are actively spreading the fruits of DIY music technology in the Maker Age.

Chapter 2

The Aesthetic Virus: Experimental Instrument Building as Biophilia and Citizen Science

"Biohacker Bach": DIY Music Technology Meets DIY Biology

"Life is nothing but mutual infection," writes Richard Powers in his novel *Orfeo* (2014, 95). The book's protagonist, Peter Els, is a retired avant-garde composer with a penchant for conducting do-it-yourself biology in his otherwise quite humdrum suburban abode. Neighbors find nothing suspicious about his experiments, writing them off as eccentricities (because, after all, "people take up all kinds of hobbies in retirement" [2]); the Department of Homeland Security, however, is less relaxed about the matter.

Els hungers to unlock hidden patterns of musicality encoded in DNA structures, which he believes would prove that music spreads through genetic material, as though a virus, and would enable future composers to create music with the sounds that inhabit all life forms. Having ages ago dabbled in collegiate chemistry, he seeks to reinvigorate his compositional aspirations via biochemical ones: "I wanted to see how life really worked and see if chemistry still wanted something from me," Els rationalizes (13). We encounter a whirlwind of goggles, gloves, and glassware; a pained narration through Els's fictional biography of an unfulfilled life in music, desperately grasping at the redemptive promise of one great, lone discovery; and an anxious portrait of the post-9/11 West, intoxicated by the thrill of recent technological trends (file sharing, home recording, social media) and the democratization of scientific tools and knowledge (through Wikipedia, blogging, Ebay, and so on), yet moving towards increased surveillance to combat the real or perceived ethical breaches these tools and technologies enabled.[87] The press christens Els as "Biohacker Bach" after the government misconstrues the artistic intentions of his viral experiments as acts of bioterrorism. A profoundly flawed character, he remains our cautiously-endorsed hero for passionately, if naively, eclipsing any last boundaries between music and life itself. We care about Els' plight because he so genuinely embraces risk in search of art—because, "Deep inside a traumatized country still dreaming of security, he listened" (282). But a crucial question lingers: does Els sincerely believe his hypothesis, or is all the science just a publicity stunt, a quest for aesthetic inspiration, one last thrust towards brilliance gone too far?

Orfeo's plot may be fictional, but its sentiments stem from present realities in the DIY music technology community. In this chapter, I focus on how DIY instrument builders use and manipulate biological themes as aesthetic and functional inspiration for designing new instruments and creating experimental sound performances. I argue for an extension of the term "citizen science" to encompass certain forms of DIY music technology. Akin to Els, my interlocutors are not professional scientists, but they are intrigued by scientific principles and they strive to contribute, in their own way, to a discourse on science in the public sphere.[88] Nevertheless, I contend that what these

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[87] In *Protocol: How Control Exists After Decentralization* (2004), Alexander R. Galloway chronicles the role of computer code as a political technology and modes of resistance such as hacking and viruses in the distribution of information (and thus of power). Steve Goodman skillfully captures the dizzying threat of sound reproduction technologies in *Sonic Warfare: Sound, Affect, and the Ecology of Fear* (2012).

[88] "Citizen science" is a contested concept, to be analyzed later in this chapter; for now, let us consider it as the public's participation in scientific activities. By "citizen," I mean a participatory stance beyond the constraints of expertise and professionalization; by "science," I refer to the paradigm of modern, Western scientific practice (Kuhn 1962; Latour 1987; Stengers 2000). As we shall see (akin to my treatment of folk or vernacular technology in others), my interlocutors complicate this paradigm, consciously or unconsciously.

musicians produce in practice is a *meditation* on science and the modern West that situates "science" as an aesthetic *experience*. By taking artistic license with scientific principles, DIY music technologists complicate the educational endeavor of citizen science, resulting in a discourse that is imbued surprisingly frequently with talk about science's historic "Other": magic. As such, this chapter explores how DIY music technologists, as citizen scientists, complicate the Western historical distinction between magic and science through instrument building. The centrality of the concept of "science" frames this chapter, just as the specter of science—and Western struggles with it—haunts the projects my interlocutors undertake.

More specifically, this chapter considers themes of virulence, contagion, and infection as examples of biophilia (the love of living organisms and systems; Wilson 1984) in DIY sound production, connecting with recent trends in a parallel growing DIY biology movement to form a hybrid "biomusic." I consider biomusic a subset of bioart, or art made with or inspired by live organisms or systems, which a growing number of theorists have begun to engage (Cogdell 2011; Kac 2007; Stracey 2009). Sue Thomas (2013) coins the term "technobiophilia" as "the innate tendency to focus on life and lifelike processes as they appear in technology," building on E. O. Wilson's original definition. For many of the musicians I consider, the concept of the virus acts, aesthetically, as a metaphor for the inescapable connection between living entities.

The city of Berlin provides the primary backdrop for this chapter. During fieldwork, I was consistently struck by the affordability and variety of public events related to DIY music technology, as well as the experimental themes of these events (much more outlandish, I would say, than those in New York).[89] In what follows, I first consider the Trockenschwimmen event series held at the Berlin venue Ausland, in which discussions of "sonic energy" and "micro activities" of nature provide an introduction to how DIY music technologists' create a discourse blurring the boundaries between "science" and artistic interpretations thereof. Next, I consider a live art installation by Diana Combo, a sound artist who creates molds of participants' ears. Finally, I return to instrument-builder Martin Howse by focusing on his micro_blackdeath noise synthesizer, a handheld experimental instrument that transmutes philosophical, literary, and biological readings of the historic Black Death plague into sound. The chapter then connects these cases with broader biological implementations in DIY music technology, including Icelandic musician Björk's *Biophilia* album and works of synthetic biology and taxidermy (in which "life" may also encompass the quasi-alive and formerly alive). Here I draw on literature from anthropology and science and technology studies (e.g., Latour 1993; Stengers 2000; Taussig 1993), bringing these into dialog with anthropological theories of *life forms*, as biological demarcations, and *forms of life*, as social ones (e.g., Fischer 2003; Roosth and Helmreich 2010).

This chapter is a response to calls for new directions in experimental music studies (Piekut 2014), but in a way typically omitted from such discussions. Approaching experimental music through critical organology,[90] the term "experiment" here takes on a double meaning, as the resulting events and instruments fall under the heading of

[89] I believe this is due to the need for financial stability to meet high costs of living in New York, which may reign in the "odd" qualities of some artists.

[90] Critical organology is a new approach in music scholarship that revisits organology, or the study of musical instruments, through the lens of critical theory (e.g., Bates 2012; Tresch and Dolan 2013).

experimental music at the same time as being a science experiment. I showcase the micro_blackdeath noise synthesizer, for instance, to push the boundaries of what instruments can be said to *be* and to *do*. Here, instruments both *are* and *engender* scientific experiments. They are also educational technologies in their own right, or conduits to knowledge about scientific principles, as spread through public workshops, radio broadcasts, and websites. I believe that considering DIY music technology as an additional, alternative model of citizen science opens the path for collective engagement with research developments from the musical layperson. Regardless of quantifiable research results, however, DIY music technologists present striking displays of self-expression in their attempts to harness, interpret, and create using life forms as tools and muses.

Life (as) Science *im Ausland*

In the midst of a brutal Berlin winter in 2012, I ventured to Ausland for the first time. Ausland, which translates as any or all "foreign countries," is an experimental music, art, and performance venue in Berlin's Prenzlauer Berg district. The name is fitting in numerous ways. Although hip, relatively pricey Prenzlauer Berg is hardly uncharted territory these days, it was once located on the eastern side of the Berlin Wall. Once the Wall fell, depressed rents and a now-central location attracted scores of artists and musicians, followed by boutique owners, restaurateurs, and others who slowly drove up the cost of living over the next two decades. No longer an *Ausland* caught between two countries, Prenzlauer Berg instead became a mecca for *Ausländer*: foreign visitors and expats looking to settle into the trendy milieu. In the summer months, for example, I wondered if I was hearing more American accents here than in parts of New York. In the midst of these changes, a collective of about a dozen Berliners formed Ausland in 2002 to host frequent, inexpensive events such as concerts, lectures, workshops, discussions, film screenings, and sound art installations. Their packed and inventive calendar, housed in the relaxed atmosphere of a mid-sized basement in the middle of a residential block, has established Ausland in the minds of my interlocutors as a champion of some of the most adventurous sounds in the city and, in its own words, its own special "territory" for exploring those sounds.

The event this particular night at Ausland, called "Sonic Architecture," was a discussion by Canadian sound artist and broadcaster Don Hill, in conversation with the British, Berlin-based instrument-builder Martin Howse. I anticipated a lecture describing the use of acoustic principles in public and private space; instead, the conversation veered into an exploration of the uncanny and paranormal. Hill described using "sonic energy" to see through walls, amongst other uncommonly held positions, which Howse tentatively affirmed. No one in the audience visibly stirred as claims ventured further afield into what I assumed to be pseudoscience. In fact, some claims may have arisen from their interpretations of government initiatives and military endeavors, which have a long, documented history of spurring developments in audio technologies.[91] But I left the venue curious if the creative community in Berlin fostered a different understanding of

[91] "Sonic energy," first and foremost, simply means sound waves; it may refer to sound level, perhaps as measured in a logarithmic decibel scale (dB) for SPL (sound pressure level). Second, it has a variety of applications in science and engineering, such as alternative energy research. Third, it may also relate to sonar as an acoustic location technology, echo mapping using microphones (Dokmanic et al. 2013), or even government surveillance technologies that attempt to "see through walls" (Hunt, Tillary, and Wild 2001), to which Hill is likely referring. Some scientists believe that sonic

Figure 10. Martin Howse and Don Hill at Ausland for CC N° 1: Corruptive Climate

science than I was used to encountering in New York and what the motivations might be for doing so.

"Sonic Architecture" was a winding-down occasion towards the end of a week of experimentation with music, biology, and technology called CC N° 1: Corruptive Climate. More specifically, it was a series nested within a series, as part of the Trockenschwimmen Biotec Lab. Trockenschwimmen, meaning "dry swimming" or "swimming on land," is a sporadic event series at Ausland for "delving into tech

energy can be used to levitate objects (Foresti et al. 2013), although very minimally (as well as conspiracy theorists, who believe, for instance, that the ancient Egyptians harnessed this power in building the pyramids). For historical engagement with "illusions" of the ear, see Schmidt 2000. I do not intend to prove or disprove any scientific theories myself; instead, I am interested in how the perception of their possibilities captures the imaginations of my interlocutors.

bricolage, sharing knowledge, learning by doing, and developing ideas together." More concretely, "Workshops [are] about basic knowledge about sound, light and electricity, mostly involving hands on work with technical devices, constructing and hacking."[92]

The Corruptive Climate sessions of Trockenschwimmen also included a workshop-laboratory leading to the creation of a Biotec Orchestra for an interactive sound art installation. "Biotec," in this case, meant harnessing the vibrations of plants to construct instruments—their low-frequency outputs, their circadian rhythms, their electric conductance of their leaves, their "micro activities"—and then using electronic devices and computer software to amplify, arrange, play, sample, and feed back the resulting sounds. When I arrived for the "Sonic Architecture" talk, the room was already bursting with the fruits of this "electro-acoustic jungle," as plant life seized the usually bare décor.[93] For the time being, Ausland's vision of science challenged humans to harness the artistic possibilities invisibly concealed within energy and nature.

Corruptive Climate would not be the last time I found my way to Ausland.[94] Months later, for instance, Portuguese sound artist Diana Combo presented her take on sound and biology in her "(ears)" residency. By this time in early July 2013, the venue (as with much of Berlin) had gone into summer hibernation. Arriving at Ausland's

[92] These quotations are from Ausland's website, which explains the impetus behind the Trockenschwimmen events in English and German: http://www.ausland-berlin.de/trockenschwimmen. Incidentally, the next addition to the series was Yuri Landmann's "DIY Experimental Instruments" workshop, held after my departure from Berlin.

[93] More information on the Biotec Orchestra event can be found at: http://www.ausland-berlin.de/trockenschwimmen-biotec-orchestra.

[94] It would be difficult overstate Ausland's importance as a touchstone for Berlin's independent musicians; wherever I have traveled, upon stating my research topic, I am asked if I have been there.

Figure 11. Entrance to Ausland, July 2013

subterranean space, I found myself one of just a few visitors, a deficit only slightly offset by the many lingering volunteers socializing over beer. The plants from Corruptive Climate long were gone, replaced by a table set with scientific equipment, wall-mounted molds of participants' ears, and photographic prints displaying the process. As an extension of a prior experience learning how to build binaural microphones, in which the position of one's ears physically directs the transduction process,[95] Combo invited various Berliners working with music and sound who had influenced her artistic thinking (members of the general public were also free to participate) to Ausland during her weeklong residency. Once there, she would cover their ears with a thin, protective layer of plastic, pour a viscous mix over the ears, and allow the mix to harden into a mold. The result was a mold of the main listening organs of people she found worth listening to—

[95] A microphone is a transducer in that it converts sound vibrations into an electric signal.

who, in turn, molded "the way she relates to sound and the listening experience, to others and the world," as her residency documents described. "What is invisible—sounds, influences, feelings—is also made silent in images that evoke the audible, the human and the perception apparatus that puts the interior in contact with the exterior, the exterior with the interior, one person with another and vice versa."[96]

Following the residency, Combo reflected on the experience for Ausland's radio broadcast, which was juxtaposed with pieces by her experimental music performance group, The Listeneur. In this broadcast, she indicated that Ausland seemed at once a "laboratory" and a "living room."[97] Although her practice is impacted by feeling like she is "not a professional" so much as a listener and a "living being," the process of setting up her materials there left Combo feeling "like a scientist." As the mold solidified around participants' ears, they would remark how strange and dissociating the process felt, how different the listening experience was from both the physical and emotional position as a subject in this experiment. Combo purposely did not tell invited participants what she found influential about them; rather, the purpose was to spur human connections based on this lineage of ideas. Public participants were also not informed about these influences; by the time of their presence on the final day, only the molds remained from this lineage. But by virtue of having shown up, they, too, entered the network of this sound-oriented community. As a listener first and then a performance artist (a live molder of influential

[96] These documents were provided as handouts at the event and can also be found at Ausland's website: http://www.ausland-berlin.de/diana-combo-ears.

[97] An archive of this radio program can be found at: http://reboot.fm/2013/07/21/raudio-aasland-31-diana-combo-the-listeneur.

ears), Combo spread and transformed ideas about sound from abstract to concrete form—a kind of artistic infection.

Figure 12. Diana Combo making a mold of a participant's ear

Figure 13. Volunteers socializing at Ausland on a slow summer evening

Figure 14. Diana Combo mixing materials for her (ears) residency at Ausland

White Noise, Black Death: The Micro_Blackdeath Noise Synth

Barely a few days after my first Ausland encounter, I signed up to summon an aural plague. Martin Howse offered a workshop on his micro_blackdeath noise synthesizer, an extraordinary handheld instrument that combines analog controls with computer code, inspired by literary, historical, scientific, and philosophical sources on the idea of the plague—specifically, the Black Death—blending science and technology with themes of contagion and the occult.[98]

The event took place at NK Projekt, a sparse, warehouse-like sound arts venue where I found myself on numerous occasions in Berlin.[99] NK Projekt lies on an unassuming block of Elsenstraße, at the edge of the gritty/artsy Neukölln district (hence the abbreviation "NK") bordering Alt-Treptow. Located on a small peninsula between the canal system and the Spree River, this area was once barely on the western side of the Berlin Wall, and an air of isolation prevails today as one makes the long walk from any given train stop. But as with all of Berlin's best-kept secrets, the venue is concealed and unadvertised: a detour down a private driveway leads to a courtyard, inside a *Hinterhaus*, up a few flights of crooked stairs.

NK Projekt was co-founded by Iranian-American Farahnaz Hatam and Australian Julian Percy to "organize public events that promote non-mainstream cultural production, and provide a platform for discussing paradigms in music and its problematics."[100] As

[98] There is also a larger, non-micro blackdeath noise synth that is octagonal rather than square. The influences analyzed here apply to both versions of the instrument.

[99] In July 2015, NK Projekt announced that it would close the venue the following September due to financial issues but would continue projects as a collective.

[100] The NK Projekt mission statement can be found at: http://www.nkprojekt.de/about.

they described in separate interviews, each came to Berlin over a decade ago to pursue art and music without the commercial constraints they felt in their prior cities, Hatam in an increasingly expensive, exclusive New York arts scene and Percy in a drug-addled, stagnant Melbourne music scene. Berlin beckoned as an affordable, artistically serious yet accessible mecca of creative freedom; however, their initial attempts to join likeminded artists faltered. Having met at a musicians' collective upon arrival, they found it too focused on techno music and drug use; their own first collective, Kita, only secured funding for one year. But NK Projekt filled a gap in the neighborhood as a community space to question, build, and perform "difficult" music and its sound-producing objects. NK Projekt is perhaps not as well known to Berlin's music scene overall, but it is a common reference point for my interlocutors and among international touring musicians (including New Yorkers) whose work does not fit neatly into a bar or club atmosphere.

Like most winter events at NK Projekt, the setting was stimulating yet bleak: a handful of eager but drowsy participants of various nationalities introducing themselves timidly, a cavernous room with grungy walls that must have once been painted white, pale gray light peeking through dreary skies as we shivered under layers of sweaters, the meager heating no match for the incessant Northern German chill. There was an awkward moment at the beginning when it seemed not enough people would show up to hold the workshop.[101] As participants trickled in, there wasn't much chatter; I learned only that

[101] Since NK Projekt does not charge for no-show registrants, it sometimes hosted workshops that were booked to capacity and then insufficiently attended; when this occurred, especially on weekend afternoons, the blame usually fell on post-party hangovers or just plain "weather." In a city where wintry temperatures lasted well into May, followed by the allure of the outdoors as soon as a belated spring arrived, there were many cancellations. (Although in this case, the micro_blackdeath workshop I attended was a second event listed due to popular request—at the sign-up phase, at

Figure 15. NK Projekt: A typical Berlin Hinterhof *(courtyard) and* Hinterhaus *(building accessible only through a courtyard)*

they were all visiting or living in Berlin for exactly this type of experience, but little else about their backgrounds or interests. But we had one thing in common: we were all there to spend seven hours of our Saturday conceptually transforming the plague into sound, simulating the *Yersinia pestis* bacterium and its effects on an imagined medieval village.

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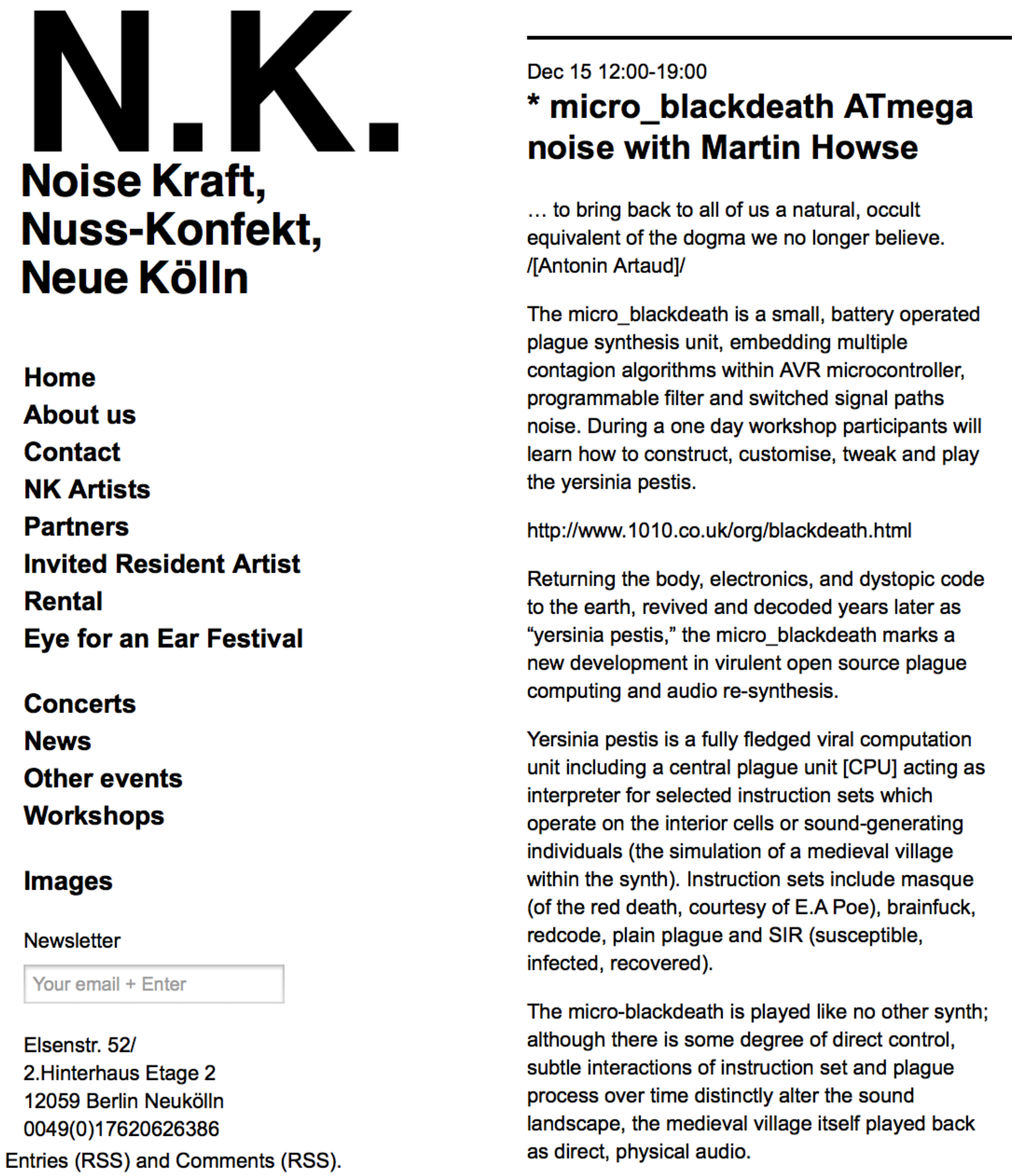
least—of the initial workshop.) Other workshops I attended, on such themes as harnessing sonic feedback for creative use and building turning empty containers into electronic "soundboxes" with Derek Holzer, had a purposefully small number of attendees in order for the instructors to assist individual participants. In contrast, evening concerts and events were often packed, with themes such as "Expanded Cinema/Live Soundtracks" and, in a nod towards American ethnomusicology, a presentation by the eccentric founder of Mississippi Records on his collaboration with the Alan Lomax Archive in New York.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*** micro_blackdeath ATmega noise with Martin Howse**

… to bring back to all of us a natural, occult equivalent of the dogma we no longer believe. /[Antonin Artaud]/

The micro_blackdeath is a small, battery operated plague synthesis unit, embedding multiple contagion algorithms within AVR microcontroller, programmable filter and switched signal paths noise. During a one day workshop participants will learn how to construct, customise, tweak and play the yersinia pestis.

http://www.1010.co.uk/org/blackdeath.html

Returning the body, electronics, and dystopic code to the earth, revived and decoded years later as "yersinia pestis," the micro_blackdeath marks a new development in virulent open source plague computing and audio re-synthesis.

Yersinia pestis is a fully fledged viral computation unit including a central plague unit [CPU] acting as interpreter for selected instruction sets which operate on the interior cells or sound-generating individuals (the simulation of a medieval village within the synth). Instruction sets include masque (of the red death, courtesy of E.A Poe), brainfuck, redcode, plain plague and SIR (susceptible, infected, recovered).

The micro-blackdeath is played like no other synth; although there is some degree of direct control, subtle interactions of instruction set and plague process over time distinctly alter the sound landscape, the medieval village itself played back as direct, physical audio.

Figure 16. Screenshot of NK Projekt's event posting for the micro_blackdeath workshop (Image: http://www.nkprojekt.de/micro_blackdeath-atmega-noise-with-martin-howse)

The Black Death was part of a wave of plagues known as the second pandemic, which devastated the population of Europe during a roughly four-hundred-year period beginning around 1346. Although most analyses are Eurocentric, the plague is believed to have originated in China, which lost half of its population as a result, and found its way to Europe through the Silk Road and Mediterranean shipping routes (Haensch et al. 2010). The responsible bacterium was only just determined (though long suspected) in 2010 through the analysis of ancient DNA and proteins from mass burials, or "plague pits" (ibid.); its genome was reconstructed (and found to be the ancestor of modern strains of *Yersinia pestis*, which is still with us today) the following year (Bos et al. 2011).[102] Media coverage of this finding would have thrust the Black Death back into the public (and likely Howse's) consciousness around this time (e.g., Wade 2010). The plague's contribution to social upheaval cannot be overstated, and it has been a source of artistic inspiration since the era of its first occurrence; plague-themed works have spanned medieval frescoes of the *danse macabre* to films such as Ingmar Bergman's *The Seventh Seal*.

In my estimation, Howse's instrument design was inspired by five primary sources. First (in no particular order), his website[103] for the instrument quotes Daniel Defoe's *Journal of the Plague Year*, a historical novel published in 1722:

> And this is the reason why it is impossible in a visitation to prevent the spreading of the Plague by the utmost human vigilance: viz., that it is impossible to know the infected people from the sound, or that the

[102] New scientific findings on the plague continue to appear and are likely to reshape our understanding far into the future. See, for example: Rasmussen, Simon et al. 2015. "Early Divergent Strains of *Yersinia pestis* in Eurasia 5,000 Years Ago." *Cell* 163 (3): 571-582.

[103] Howse runs the website micro_research (www.1010.co.uk) as a platform for documenting his essays and instruments.

infected people should perfectly know themselves. [220]

Here, "visitation" refers to the onset of the "Great Plague of London" in 1665, also considered a recurrence of the second pandemic. Meanwhile, "sound" takes on a double meaning: for Defoe, of sound health and mind, and for Howse, an aural marking of the infirm or, perhaps, of the plague itself.

Second, Howse's website juxtaposes photos of the instrument with an image of Pieter Bruegel the Elder's painting *The Triumph of Death* to reflect the ever-looming threat of social upheaval, terror, and despair following the plague in medieval Europe. The painting characterizes an overarching theme of Howse's aesthetics: the dismal relationship between science, technology, and chaos, amidst the threat of societal and environmental destruction. Upon further examination, we can also see a medieval soundscape embedded in the chaos. At the top left corner, skeletons toll a death knell on a bell suspended from a lifeless tree. At the bottom right, a seemingly oblivious couple strums a lute while a skeleton mimics their playing behind them. Another skeleton aboard a cart overflowing with skulls cranks a hurdy-gurdy as the cart crushes the living beneath its wheels, while yet another forcefully beats a set of drums. These examples are in addition to the bursting of cannons, the clanging of swords, among countless other sounds evoking battle, death, and despair.

Third, Howse was drawn to a project by Swedish conceptual artist Leif Elggren called "Virulent Images/Virulent Sound." An accompanying CD contains recordings of so-called "samples" of "highly potent viruses" made in a medical laboratory in Libya. The CD cover offers a statement claiming that "NASA Medical Research Laboratories… have found evidence that viral diseases like Cancer, AIDS, Ebola, etc. are being

Figure 17. Pieter Bruegel the Elder's The Triumph of Death *(c. 1562)*
(Via Wikipedia; public domain image)

transmitted through visual aspects and methods" and that "the visual structure of the virus system strikes the eye and transforms its information in the human brain back to a substantial living virus that will attack certain parts of your body…. Don't look at the image!" It then asks, "If images can be virulent, can sound be virulent too?" This statement is, of course, patently untrue, and the supposed NASA document was a conspiracy theory circulated on the one-year anniversary of 9/11, which has since disappeared from print (Goodman 2010, 133; Bailey 2009, 124). Both Howse and Elggren evade clarifying whether they believe in virulent images and sound or draw on this faulty science as an artistic muse; I presume the latter, taking it as a form of agitprop to draw attention to media responses to social unrest and viral activities (physical or otherwise) and, as Thomas Bailey puts it, "transposing the current discussion of terrorism onto the realm of microbiology" (2009, 123-124). For their part, Elggren's record label, Firework Edition Records, notes on the cover that they do "not take responsibility for any diseases caused by this CD."

Fourth, Howse incorporates themes of the occult into the micro_blackdeath, among many of his other projects. *Occult* can be defined as knowledge of the hidden, or, commonly, knowledge of the paranormal, as opposed to the measurable. In an essay titled "Technology and the Plague" (2012),[104] he invites us to question what kind of dogma contemporary technology espouses, in turn citing Antonin Artaud's chapter "The Theater and the Plague": "…to bring back to all of us a natural, occult equivalent of the dogma we no longer believe."[105] Howse refers to his instruments as "a series of divinatory noise modules" (ibid.) connecting the occult to the divine through the idea of revelation (especially through the concept of *scrying*, which is realized more fully in the micro_blackdeath's successor, the Dark Interpretor, to which I will return below).

In tandem with this idea of the hidden and the revealed, Howse's fifth inspiration is Edgar Allan Poe's "Masque of the Red Death" as a guiding structure for the computer code programmed into the instrument. He uses this code as "a simultaneous hiding" through embedding it in the micro_blackdeath and as a "revealing" through the use of open software and the process of holding educational workshops "both in and as an attempt to contain against infection." In his opinion, "Software is both invisible and is a

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[104] This essay is available on Howse's website at http://www.1010.co.uk/org/plague.html and also appeared in the journal *Acoustic Space,* Issue 11, in the same year.

[105] This is quoted in my source, the book *The Theater and Its Double*, as, "…to restore to all of us the natural and magic equivalent of the dogmas in which we no longer believe" (1958, 32). Howse's translation from the original French may differ.

revelation." The risk of "obscuring within this domain include blackboxing or abstraction," including overbearing computer security and privatization or commercialization of designs. Therefore, responding to Artaud's claim that "the most terrible plague is one that does not disclose its symptoms," he seeks to write "an invisible code with visible symptoms"—except, instead of vision, the micro_blackdeath translates its infection into sound.

The instrument was available for purchase online, or one could order the unassembled parts as a kit. Howse suggested, however, that users should opt to build experimental instruments under their inventors' guidance whenever possible, rather than risk mistakes tinkering at home. In the workshop, after following an electrical schematic to solder components to the board of the micro_blackdeath, computer code was then transferred onto each individual instrument through a parallel or serial port programmer, which sends data to any onboard microchips, the language of which was deciphered and analyzed.[106] The code was advanced, reflecting Howse's deep experience working with computers, but those without prior background could still follow along with the poetics buried inside. The commentary to the coding instruction set traces the path of the plague through the hours and the seven rooms:

> *// reddeath*
> *//1- the plague within (12 midnight) - all the cells infect*
> *//2- death - one by one fall dead*
> *//3- clock every hour - instruction counter or IP -some kind of TICK*
> *//4- seven rooms: divide cellspace into 7 - 7 layers with filter each*
> *//5- unmasking (change neighbouring cells)*
> *//6- the prince (omem) - the output! walking through 7 rooms*
> *//7- the outside - the input!*

[106] The chip in this case was an AVR microcontroller chip called an ATmega, which functions like a very low-capacity hard drive.

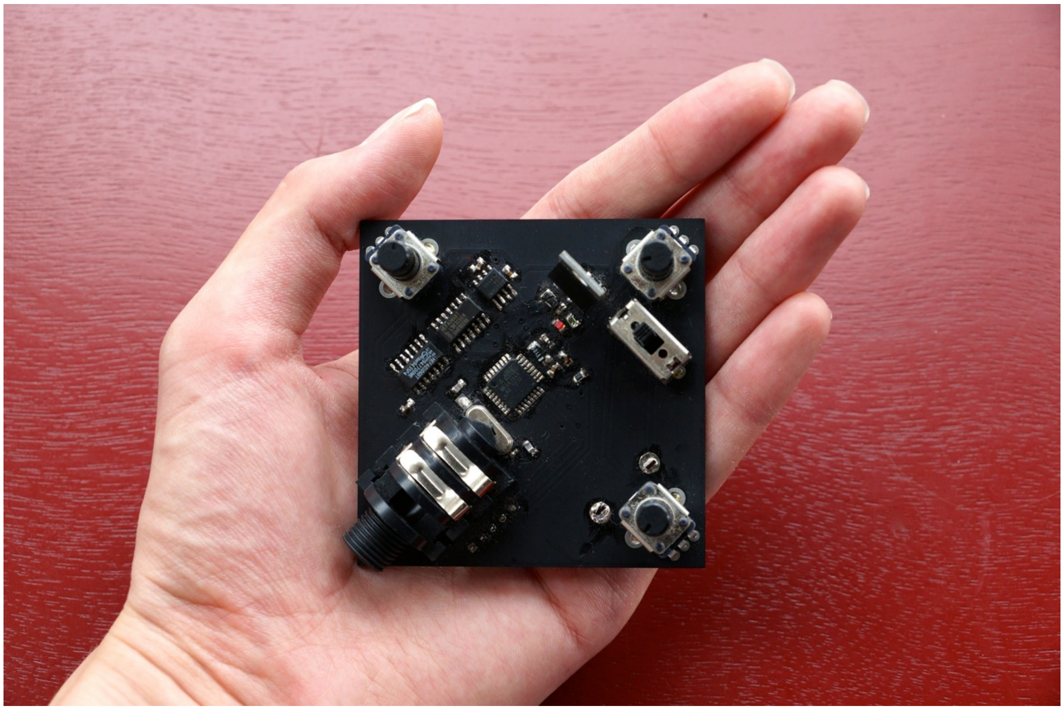

Figure 18. A micro_blackdeath noise synth, built by the author

Howse bases another instruction set on the "redcode," which he calls "one of the first inspirations for computer viruses." An additional set, SIR (susceptible, infected, recovered), reads as: *// SIR: inc if, die if, recover if, getinfected if.*

Given the difficulty of building and programming the micro_blackdeath, why not just use existing computer software to make these strange sounds? Howse told participants that he is more interested in "introducing indeterminacy and analog uncertainty into the digital signal." Part of this indeterminacy is embedded in the code itself, but we also learned why certain integrated circuit chips were selected;[107] the 40106 chip, for instance, provides the circuit with its "crunchy," lo-fi sound, and each chip is

[107] An integrated circuit (IC) chip is a miniaturized combination of circuits made from electronic components that is etched onto semiconductor material (typically silicon). The chips can have different designs and functions, so that certain ones might be more appropriate for a given DIY music technology project than others.

slightly different from the last, suiting Howse's desire for "low-budget noise adventures."[108] Ultimately, analog and digital data (posing as bodily "cells") changes, depending on what else is happening around the instrument, and the goal is to "use contagion to manipulate sound." The end result may simply sound like noise—and it is. But to Howse and the organizers at NK, mixing theoretical discourse and technical experiments serves the interest of exploring uncharted sonic territory.

As of summer 2014, the micro_blackdeath has been discontinued; Howse has moved onto other projects, including a follow-up called the Dark Interpreter. His new invention is a series of three similar instruments that are "influenced and guided by body capacitance, skin resistance, biological micro-voltages and the fleshy conduction of all signals" (Howse 2014).[109] This time inspired by the essays of nineteenth-century English writer Thomas De Quincey, Howse explains, his instrument design "seeks to return all contagious execution to the skin, rewriting the history of technology as a plague which has always attempted to shift that site into the earth itself" (ibid.). To play, users twist knobs (potentiometers) and place their fingers on pads (obsidian mirrors) on the instrument's surface. Like the micro_blackdeath, particular patterns of movement do not directly correspond with particular sounds; the instrument instead functions as a "dark symbolic mirror" "without screen, keyboard or conscious control" (ibid.). The use of mirrors is connected with the aforementioned term *scrying*, in which one peers into a

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[108] In prior workshops, I had learned that the 40106 is part of a category of IC chips called CMOS, or Complimentary Metal Oxide Semiconductor, that have a range of uses in the audio world, namely as the driving force behind many basic synthesizers and oscillators.

[109] Howse describes the Dark Interpreter on his website: http://www.1010.co.uk/org/darkint.html

reflective or translucent surface in order to gain insight or hidden knowledge, such as visions into the future.[110]

The connection between sound, technology, and earth, on the one hand, and pushing boundaries between science and pseudoscience, on the other hand, is at the heart of Howse's recent work.[111] He groups his projects under the name "micro_research," with "psychogeophysics" as their unifying theme.[112] Psychogeophysics is an obscure neologism that combines the existing fields of psychogeography and geophysics, a "collision between interpretation (fiction) and measurement" of "the earth's physical properties." As a collective activity, its practitioners are interested in a unique variety of citizen science—and pseudoscience, in this case: "interdisciplinary public experiments and workshops excavating the spectral city and examining the precise effects of geophysical/spectral ecologies on the individual through pseudo-scientific measurement and mapping, algorithmic walking and the construction of (experimental) situations." Such experiments might include the instruments of scrying, the detection of low frequency transmissions in the environment, or the recording of electronic voice

[110] The most famous examples are the fortune-teller gazing into a crystal ball and the Queen's magic mirror in the fairy tale "Snow White," but scrying is used in many eras and cultures for divination, trance, and revelation, from seer stones to the ancient Persian Cup of Jamshid to the Mesoamerican use of obsidian to reflect one's destiny.

[111] Meanwhile, NK Projekt proceeded to offer further events in this vein throughout the following months, including "Relational Machines for Ephemeral Experiences," based on designing a "space-machine" on the concept of "action and animal spirit."

[112] Howse also appears to run a site called psychogeophysics.org, given the similar writing style and references to his work and influences. The following quotations in this paragraph are from this website but cannot be attributed to any particular author at this time.

phenomena (EVP).[113]

When I followed up with Howse in July 2013, he was recovering from a somewhat unsuccessful attempt to communicate with plants through measurable data readings and was preparing for a trip to Pyhäjoki, Finland.[114] There, he was set to lead DIY workshops at the site of a planned nuclear power plant, teaching locals to build their own nuclear radiation detectors, or Geiger counters; the counters produce distinctive audible clicks that are heard more frequently as more radiation is detected. Howse's projects that are not intended to help people in a direct, quantifiable fashion may wander frequently into pseudoscience; here, however, when the fear is the actual spread of radiation (and no longer an artistic interpretation of contagion), his work foregrounds scientific principles. Consequently, on the one hand, Howse shifts between aestheticizing science and practicing citizen science depending on the desired outcomes of the situation. On the other hand, teaching micro_blackdeath workshop participants skills such as soldering and coding is its own form of citizen science, while teaching Geiger counter workshop participants to build their own radiation detectors—a sound-producing instrument of a different kind—from scratch can also involve some degree of

[113] EVP is a paranormal phenomenon in which speech-like sounds are detected through stray or static audio transmissions and attributed to the voices of spirits, aliens, or various forms of energy.

[114] Many DIY music technologists in Europe earn a portion of their income in Scandinavia, where financial support for the arts is unparalleled, and then return home to workshops and arts scenes in less expensive cities.

creativity.[115] Thus, art, science, and environment are never truly divorced, as Howse's work comes full circle from instrument to biology, in a kind of sonic-techno-ecology.

Virus, Magic, Music

"Viral tropes," writes media arts scholar Douglas Kahn, "show no sign of backing off. They have proven as pervasive and contagious within culture as actual viruses among their host populations, no doubt because they can chose among any number of hospitable cultures" (1999, 294). Within early sound art, Kahn draws attention to the sonic experiments of William Burroughs, who captured the language and sounds of biology in his writings on the virus. Viral sounds infected the urban soundscape as a "medley of tunes and street noises," "Radio Cairo screaming like a beserk tobacco auction," and "flutes of Ramadan fanning the sick junky like a gentle lush worker in the gray subway dawn," among other examples (cited in Kahn, 308). For Burroughs, the virus was a "degeneration from a more complex life form…. [now] the renunciation of life itself, a *falling* towards inorganic, inflexible machine, towards dead matter" (ibid.), an early idea that he complicated and amended over time. His audiotape and phonographic experiments also turned memory, perceived as inscribed at the cellular level, into sound, and the voice became an instrument of remembrance. It also became an instrument of pseudoscience, as Burroughs was initially inspired by his encounters with Scientology. The author was no stranger to psychophysical quackery, previously taking up the

[115] In fact, Geiger counters have long been incorporated into musical expression. See German band Kraftwerk's song "Radioactivity" (1975) and the WMD Geiger Counter distortion guitar effects pedal. *Make Magazine* also shows how to build a DIY Geiger counter kit, which they insist is for educational purposes rather than scientific reliability (http://makezine.com/projects/geiger-counter-kit).

galvanometric readings of Count Alfred Korzybsky, the orgone accumulators of Wilhelm Reich, and purporting himself to have found "the key to addiction, cancer, and schizophrenia" (ibid.).

This "borderline between living and dead matter" taken up by Burroughs has been analyzed more recently by Jason Stanyek and Benjamin Piekut (2010) as the "intermundane"—of existing between worlds—or, for them, a straddling of living and dead voices initiated by the advent of recording technology. This technology, they argue, enables a form of co-laboring between interworldly collaborators. Opposite Burroughs, we might say, this process allows for the re-created spread—contagion, even—of musical influences and efforts across time and space. As seen in work on sound studies by Jonathan Sterne (2003) and others (e.g., Brady 1999; Taussig 1993), sound technology has been used for preservation, for transmission and communication, as well as to reinforce alienation at the same time it circumvents it. Technologies of audition address the biophysics of the hearing, of the deaf, of sound waves, sonar, and sensation. The media for transmitting sound can incur smoothness of signal, interruption, or silence; it can be hacked, as in the case of so-called "zombie media," Garnet Hertz and Jussi Parikka's (2010) term for the repurposing of previously obsolete electronic materials used to create instruments through the practice of circuit bending. One can even "hack" one's own DNA for sonic purposes, as with "Bio-music" (hyphen theirs), which purports to analyze and compose music based on your personal genetic sequence. As commercialized here by Bioartz, the so-called "true music of self" is translated through science into a "magical experience."

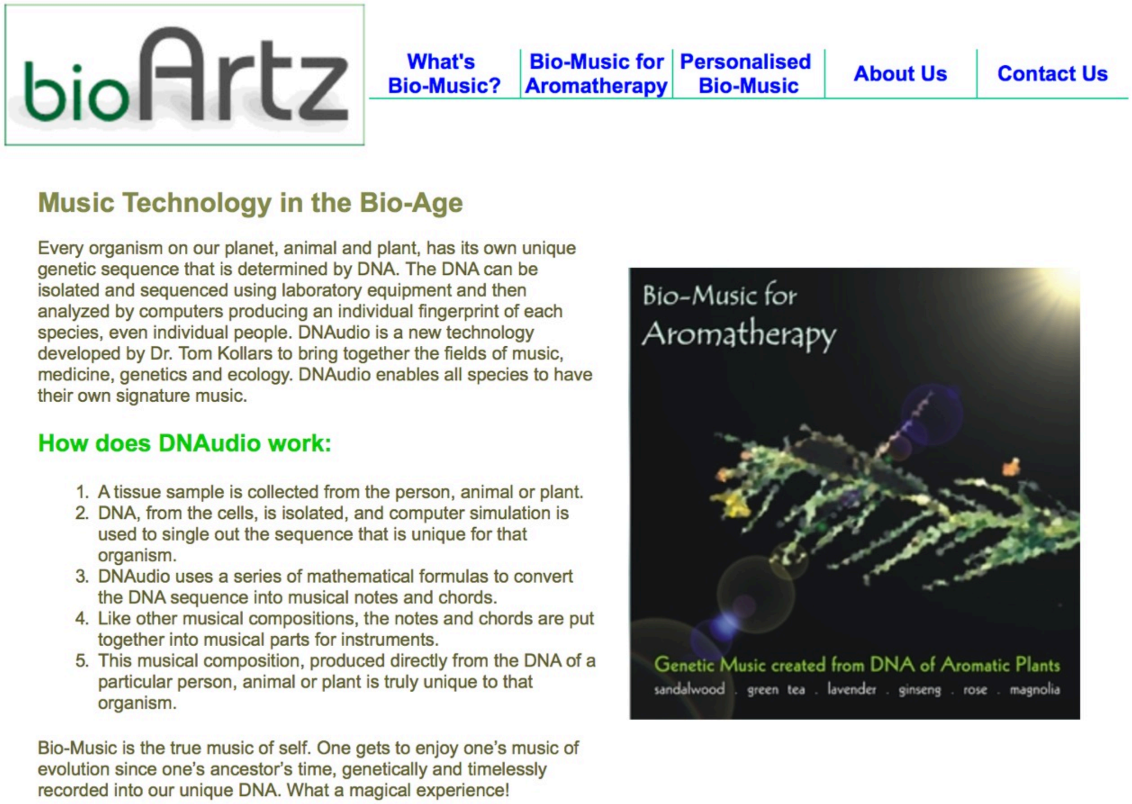

Figure 19. Screenshot of BioArtz website[116]

In coining the term *memetics*, Richard Dawkins famously declared a *meme* to be a kind of nongenetic pattern replicator, performing a similar function within culture as DNA does in biology (1976); in essence, ideas become viruses spread from person to person. Others have since developed memetic theory, from Manuel de Landa to Frank Gunderson to Steve Goodman, who critiques its emphasis on "sonic branding" but retains interest in what it can tell us about the "viro-sonics of capital, engineering self-propagating vectors of contagious sound, unleashing a population of predatory 'earworms' into the public domain" (2012, 139)—earworm, of course, coming from the

[116] This image and accompanying citations are from the website www.bioartz.com/biomusic/biomusic.html. Last accessed August 20, 2015.

German *ohrwurm*, as an “infectious musical agent” (147). Recalling Michael Veal’s work on dub, Goodman theorizes a “dub virology” that employs electronic sound effects such as echo, delay, and reverb as a kind of “sonic seduction”—one that replicates the original sounds, albeit through a process of decay, as the reverberations of sound waves bounce around a given room. These copies become ghostly traces, or “audio hallucinations” of their originals, but “hack into sonic objects, catalyzing mutations into monstrous, uncontrollable morphologies” (160).

Meanwhile, Barbara Browning analyzes the spread of so-called “infectious rhythms” through the lenses of virus, disease, and contagion from the Africa diaspora, writing, “The metaphor is invoked—often in the guise of a ‘literal’ threat—at moments of anxiety over diasporic flows, whether migrational or cultural” (1998, 6).[117] This threat is precisely why I believe the virus trope remains so effective and so popular among artists: it engages the desire for human connection, but it is a *forced* connection, one between organisms whose very lives hinge on its range and potency. The threat seizes our attention, and the connecting threads woven by the virus’s spread retain it.

The most prominent example of biology as an inspiration for instrument-making comes from popular music: Björk’s 2011 album *Biophilia*. The term *biophilia*, coined by psychologist Erich Fromm in 1964 and developed by biologist E. O. Wilson in 1984 (as mentioned earlier), has now entered popular culture and is often defined as “a hypothetical human tendency to interact or be closely associated with other forms of life

[117] Given the media climate upon this initial writing in October 2014, I am struck by parallels to the current Ebola scare and the public hysteria and hyperbole in the U.S. in response to the Ebola outbreak in West Africa.

in nature."[118] For this ambitious endeavor spanning songs, new media, and traveling workshops, Björk sought to explore human relationships with sound and nature and to spark an interest in educating oneself about science.

The song "Virus," for instance, features handmade instruments from builders who have brought DIY out of the basement and into small business territory. First is the "hang," a UFO-shaped percussion instrument, alternately called a sound sculpture, from Swiss collective PANArt Hangbau, based on a steel drum, but enclosed to create a phenomenon called Helmholtz's resonator.[119] The second is a "gameleste," a MIDI-controlled combination celeste-gamelan instrument commissioned from British cymbal-maker Matt Nolan. Another song, "Solstice," is about the earth's rotation and gravitational pull and thus featured a "gravity harp" by Brooklyn-based experimental instrument-builder Andy Cavatorta. Additionally, "Thunderbolt" employs a Tesla coil to play rumbling, bass-like arpeggios.[120]

The album also spawned an iPad app, narrated by broadcaster and naturalist David Attenborough, that allows users to play with altering song structures based on the interactive application of scientific principles; app designer Scott Snibbe states that the

[118] The term is now included in the Merriam-Webster Dictionary online: http://www.merriam-webster.com/dictionary/biophilia.

[119] Early figure in modern acoustic science Hermann von Helmholtz designed spherical cavities meant to emphasize certain frequencies over others (1885).

[120] Tesla coils are gaining popularity in the Maker Movement; I encountered one at Maker Faire 2013, where the start-up company oneTesla showcased its DIY Musical Tesla Coil Kits. The coils, invented by Nikolai Tesla circa 1891, are high-voltage electrical resonant transformer circuits primarily used for experimental and educational purposes. Within music, they work in combination with microcontrollers that interpret MIDI data, which is then output as a pulse-width modulation signal and sent to the coil through a fiber-optic cable. The coil emits sparks at programmed intervals, which produce audible frequencies.

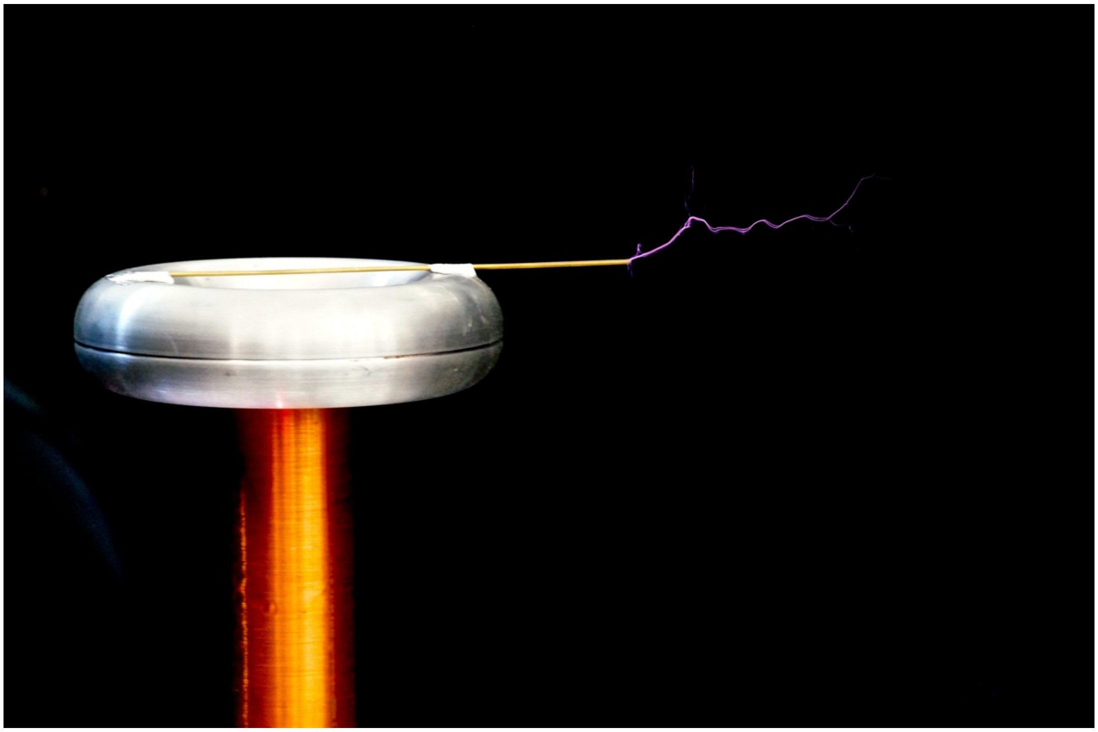

Figure 20. Singing Tesla coil by oneTesla, Maker Faire 2013

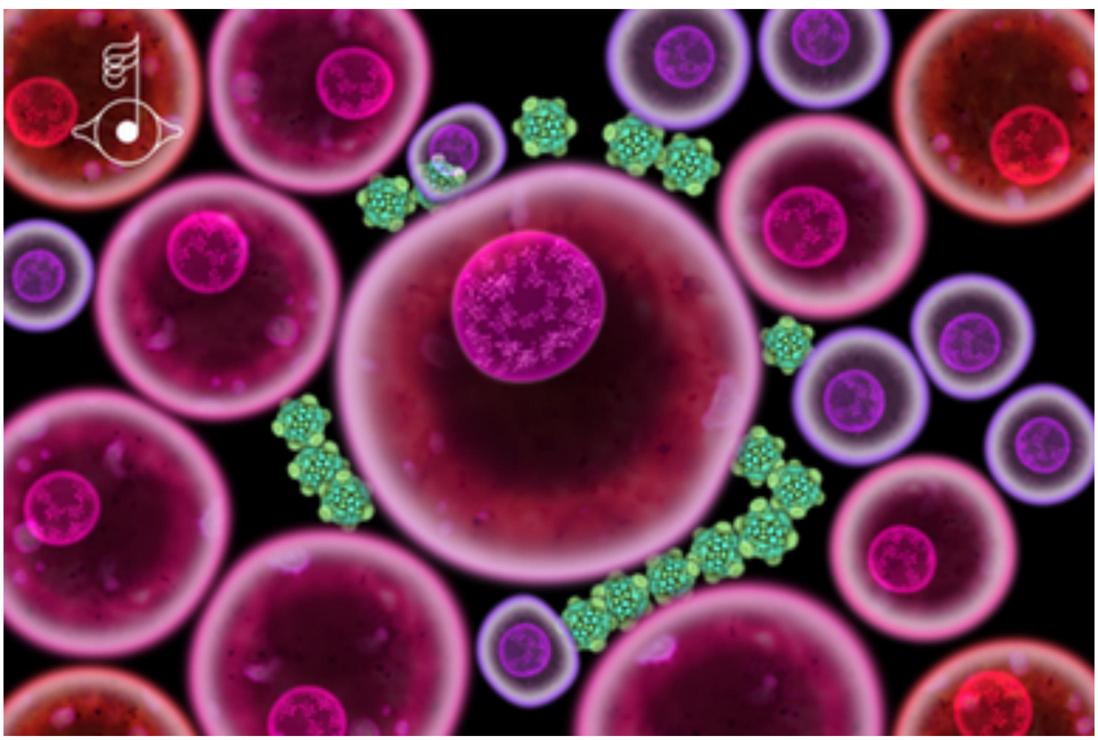

Figure 21. Screenshot of "Virus" iPad app
(Image via Wikipedia: https://en.wikipedia.org/wiki/File:Virus-capture-12.png)

“Virus” portion, in which users aim to protect or infect cells, reflects the song as “a kind of a love story between a virus and a cell. And of course the virus loves the cell so much that it destroys it" (Cragg 2011). Additionally, Björk initiated the Biophilia Educational Program to bring traveling, interactive science and music workshops to children in numerous cities. The entire *Biophilia* project renders the private public, bringing the individual level of the cell as well as the individual creation of songs and instruments into an interactive communal space for connecting audiences to the arts, albeit with a sheen and layer of removal from the average participant that we would expect a pop star’s initiative to maintain.

In contemporary installations bridging sound art with experimental instruments, a prime example is the Secret Sounds of Spores project in Edinburgh, which uses an Arduino microcontroller to turn microscopic patterns of falling mushroom spores into musical instruments. And in Robert Kirschner’s exhibit, *Roots*, crystalline structures grow in a tank, developing into various constellations and eventually dissolving, all the while sounding out their growing pains. He made this for the “Synth-ethic” project on art and synthetic biology that is related to the “Bioart-Club” Pavillion 35, a part of the “European Do-it-yourself Biology Network.”

DIY biology found its first references in the 1950s and 60s, when the journal *American Biology Teacher* suggested a “Do It Yourself Microbiology Kit” for the classroom (Lange 1960). The idea caught on more broadly, though only in the early 2000s, also under the headings of “biohacking” and “garage biotech,” due to falling costs in computing equipment and the ability to buy used scientific gear online, as well open-source software and new inventions like the Arduino and 3D printers that make material fabrication easier on an individual scale.[121] DIY biologists sometimes operate out of communal spaces, such as New York's DIYBio group, which meets at electronics hackerspace NYC Resistor. (This group has since morphed into Genspace, a growing entity with a venue of its own in downtown Brooklyn.) Pavillion 35's purpose is reflective of many DIY biology communities: "to enable an exchange of ideas, expertise and practices between biologists, social scientists and artists. The interdisciplinary collaboration allows for theoretical reflections about the practices in biology and art, and its societal ramifications but also provides the means for hands-on laboratory activities for artists and other biotechnology newcomers."[122]

But there is also danger here: noting the rise of synthetic biology as a field and its adaptability outside the realm of academic and industry laboratories, Julie Palakovich Carr writes, "Experts in ethics, biosecurity, and law also see cause for concern. […] Doubts linger about gaps in the current regularly framework to oversee privately funded research, especially that of 'do-it-yourselfers' who work outside of agencies, university, and corporations (2011, 268)." Not to mention that the FBI's bioterrorism unit is frequently not amused by amateur experimentation, though DIY biologists are working to improve this tense relationship (Kean 2011).

One could view the work of all these strains of DIY enthusiasts through the lens of Claude Lévi-Strauss's *bricolage* (1966), or a construction of a work made with whatever materials happen to be available, which "has been widely adopted within anthropology to refer to the creation of symbolic structures from a variety of cultural

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[121] The Arduino microcontroller and 3D printing, the two most prominent technologies adopted by the Maker Movement, are discussed in chapters 1 and 3.

[122] Documentation is at http://pavillon35.polycinease.com.

available symbols" (Bowie 2000, 79), not to mention by scholars of punk rock (Hebdige 1979). *Bricolage* also translates from its original French as "do-it-yourself," and while I do not believe that DIY music technology as a whole fits Lévi-Strauss's theorization—the dichotomy between the "savage mind" of the bricoleur and the scientific mind of the engineer is too jarring for this case—here I find the term appropriate for considering the juxtaposition of materials and symbols at hand.

In Jean Comaroff's study of Zionist Christianity in South Africa, she states that Zionism "opened up a general discourse about estrangement and reclamation, domination and resistance" that "stretched far beyond the domain of ritual itself, penetrating acutely into the experiential fabric of everyday life" (1985, 11). Further, "The rituals of Zion are a *bricolage* whose signs appropriate the power both of colonialism and of an objectified [Tshidi] 'tradition,' welding them into a transcendent synthesis; an integrated order of symbols and practices that seeks to reverse estrangement, to reconstitute the divided self" (12). A figurative world away from the struggles of South African Zionists, threads of symbolism and resistance (regarding Western belief systems) also connect ritual activity to the everyday in Berlin and New York. We might call it, too, a synthesis (*synthetic* is a key term to which I will return) of seemingly contradictory beliefs about science, magic, and the power of artistic practice, with its ear to a kind of transcendence—or perhaps just a reversal in response to an estrangement that would squeeze amateurs out of increasingly specialized professional roles in science and technology.

This synthesis came to a head at New York's Dark Circuits festival in June 2014, which brought together DIY music technologists from the United States and Europe,

Figure 22. Mario de la Vega's goat's foot instrument,
Dark Circuits Festival, June 2014

primarily Germany (discussed further in the conclusion to this dissertation). Before and after the primary concert, the audience wandered over to tables where equipment was set up in order to view the creations up close and ask the questions of the inventor-performers, as is customary at such an event. Mario de la Vega, a Berliner originally from Mexico City, and his goat's foot instrument received the most attention; even for an event featuring experimental instruments, a taxidermy animal part stood out. Having seen de la Vega perform many times (at New York's Bent Festivals and Berlin's LEAP venue) with other instruments of his own invention, I asked what drove this particular creative choice. He described his approach as a kind of "raw electronics." Lacking formal training in electronics, he instead aims directly at communicating with others through expressing his experience of learning how things work; his instruments are meant to sparkcontemplation and conversation. In this case, de la Vega is inspired by the folk traditions of Mexico, where he feels the pull of "syncretism" is stronger, blending religious aspects and ritual. He says the goat's foot is about "fetishization"—"that we *need* ritual, we need interesting objects in our lives…that people need the unique…there is value to the unrepeatable instrument or performance." De la Vega, too, is intrigued by science experiments. He appreciates Martin Howse's work and planned at the time to return to Germany to conduct a sonic experiment of his own, a foray into psychoacoustics and infrasound for an artistic residency. The residency would culminate in an installation consisting simply of an empty room, but filled with low frequencies that cause optical illusions and could even make visitors feel sick. (When asked if this was dangerous, he replied, "Yes…you will need a waiver.")

What other rituals do DIY music technologists encounter? A central site for the production and reproduction of DIY aesthetics, and also the central mode of gathering for DIY music technologists, are the small-group workshops held to teach technical skills, such as those held at NK Projekt or Ausland. These range in goals, costs, and prerequisite knowledge, but generally offer some variation of learning basic electronics, replicating an instrument invented by the instructor or building a personalized version inspired by it, and sometimes working with computer coding or audio software. I find that the workshop, in this case, is a form of ritual—an initiation process or rite of passage for nascent builders—where they learn the appropriate materials, knowledge, and behaviors for participation. The twist here is that when dealing with experimental instruments, a collage of desires and meldings of backgrounds adds a sense of difference. It is an efficacious ritual, as in having the ability to effect a transformation, and an enactment. And it is a ritual combining resistance with reinforcement of group norms; here, an instructor guides participants through the process of building, reconfiguring, or otherwise exploring sound-producing instruments. In theory, these rituals can be repeated indefinitely, as each instructor may harbor different skills and materials to share. But more often, participation tapers off once the nascent builder gains confidence to pursue more independent projects; the number of workshops attended will be different for each person, depending on skill level and interest.

Workshops are also rituals of control. Stanley Tambiah writes of "magical acts as being coercive rituals ambitiously attempting to manipulate the divine" (1990, 19). But from the Protestant Reformation onward, magic was thought to be not only false religion, but also ineffective action. Historically speaking, a combination of rationalism and empiricism informed by religion eventually replaced magic and the occult in the Western narrative. In turn, religion—specifically Protestantism and the belief in God's purposeful order of the universe—was "a mental environment which made possible the triumph of technology" (11). Or, as Talal Asad put it, modernity

> employs proliferating technologies…that generate new experiences of space and time, of cruelty and health, of consumption and knowledge. The notion that these experiences constitute "disenchantment"—implying a direct access to reality, a stripping away of myth, magic, and the sacred—is a salient feature of the modern epoch. (2003, 13)[123]

[123] On the idea of modern enchantment, Robert Sharf discusses such "phenomena in which there seems to be an odd marriage of modern 'scientific thinking' with more

Thus, in twenty-first-century Berlin, one would suspect neither religion nor magic would play a role in a technical workshop. But the sense of control of technology, I would argue, comes into contact with magic through the use of false, or pseudo-, science in the former case study of the micro_blackdeath, with the building process here resembling a ritual of transformation. In fetishizing scientific objects and ideas—here, specifically, biophysical phenomena—DIY music technologists playfully contest the boundaries of science and magic, grappling with the aesthetics of sound and music while also questioning the role of the self and community through a critical relation to capitalism and consumerism. I contend that these transformations entail a way of "becoming," or of the co-constitution of self, sound, and instrument (as argued in the introduction). All elements are constantly in flux throughout the building process, as the participant acquires skills, knowledge, and ideas. DIY music technologists typically operate between or under the radar of various institutions, such as universities, arts organizations, and start-up companies, and frameworks (such as hacking, the Maker Movement, and the myth of the genius lone inventor); as a result of their creative marginality and the ever-present transformations at hand, they generate their own slice or layer of a worldview, situated within the larger worldview of Western cosmopolitanism.

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traditional 'systems of belief'" (2005, 3). He positions these phenomena as the logicians' "category mistake," the sociologists' blurring of "epistemic registers," or, more plainly, as a kind of "confusion" (ibid.; drawing on Schneider 1993, 10). Sharf finds that we commonly address these contradictions "under the Weberian rubric of 'reenchantment'—a response to the instrumental rationality and spiritual sterility of the modern world" (ibid.). However, scholars often cannot agree upon the distinct modes and methods of reenchantment: "They argue that historically there has never been a clear distinction between magic, religion, demonology, rationality, and science [and to this I will add the occult]" (4); as such, the extent to which people can be enchanted, disenchanted, or reenchanted remains unclear.

What is intriguing about the micro_blackdeath is its inherent paradox of revealing and concealing sounds and knowledge. While I theorize this paradox elsewhere as a "black box" (Latour 1987), let us further consider the implications of magic here. DIY music technology, at its core, is about revealing the inner workings of instruments, yet practitioners can and sometimes do project the persona of the magician, the technical wizard.[124] Beyond the peculiar events hosted in Berlin, I routinely heard such language throughout my fieldwork: soldering irons described as "magic wands" and my interlocutors as "wizards." Consider this exchange from the livestream of New York's 2014 World Maker Faire, in which two anonymous correspondents for *Make* magazine visit the "Learn How to Solder" tent:[125]

> Correspondent 1: "It's the closest thing we have to magic. You're casting a spell. When you build a circuit, you're able to take these different pieces, and you can make something magical happen. You're making a light turn on. If you think of the attraction of Harry Potter…and how there's this incredible story about this boy who's learned how to become this master wizard…these are all of our wizards, being trained right now to make magic."
>
> Correspondent 2: "With the soldering iron as their wand?"
>
> Correspondent 1: "It really is! Yes. It really is. You're manipulating these elemental pieces…you're melting metal to create these bridges that then, when activated, something entirely different happens."
>
> Correspondent 2: "It's a great analogy."

[124] See also Stahl 1995 for an overview of "magical" language in the popular press regarding computer technology (especially young hackers as "sorcerer's apprentices"), which was viewed as both a savior and a threat. For an account of how another type of magic, witchcraft, or Neo-paganism, is encountered and practiced in the contemporary West, see Magliocco 2004.

[125] My experience at Maker Faire 2013 is discussed at length in chapter 1. For Maker Faire 2014, I attended on one day and analyzed the livestream hosted on Youtube by *Make* as events unfolded on the second day, September 21, 2014.

> Correspondent 1: "I think it's phenomenal. I look at welding much the same way. It's one of the coolest things. This is sort of a precursor to welding. What cooler thing is there…to take two pieces of metal and combine them into *one piece of solid metal*? This is a similar thing. You're creating magical devices."
>
> Correspondent 2: "From bits that mean nothing and do nothing, into a thing that has a purpose and a meaning."
>
> Correspondent 1: "A blinking light at the simplest, to a smartphone in our pocket that can make telephone calls or *video* calls to the other side of the planet. We are creating magic!"
>
> Correspondent 2: "That was great, that was great [*chuckling*]."

The modern is so thoroughly characterized by the rational, the empirical, and the scientific, among other attributes, that to resist these is an art in itself (Asad 2000; Latour 1993; Meyer and Pels 2003; Sharf 2005; Stengers 2000; Styers 2004).[126] Bruno Latour, for instance, discusses various strategies for recognizing ourselves as *amodern* (1993), while Michael Taussig views sound reproduction technologies as reflections of our "indecisive struggle between technology and magic, indicating co-dependence" (1993, 224), especially current fascination with the now outmoded phonograph (232).[127] In fact, he asserts in impassioned language:

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[126] The literature on magic and modernity is too vast to cover in depth here; in one summation, Robert Sharf states that magic played a "rhetorical role" "in normative discourse on modernity" (2005, 5). He characterizes this discourse in terms of "rationality, instrumentality, free agency, and transparency, i.e., the notion that the mechanisms of political and social institutions are available for investigation. Magic, on the other hand, is characterized by secrecy, concealment, and the belief that the connection between means and ends—between action and result—are opaque and unavailable for scrutiny" (ibid.). Lest one think this discussion is only confined to the West, Sharf provides an example to the contrary from debates over the Buddhist meditation styles of *vipasynana* and *samatha*, the former of which might be described as "everything essential," while the latter is "the really strange stuff, including all sort of acknowledged holdovers [that are] fun to have but not requisite for enlightenment" (6).

[127] In fact, Taussig references Frazer's 1911 discussion of "sympathetic magic" in *The Golden Bough*, which is split into "imitative" and "contagious" domains (1993, 220).

> "The commodity does more than yield the measure of history as time. It is also the petrified historical event where nature passed into culture, where raw material combined with human labor and technology to satisfy cultured design. Standing thus at the crossroad of past and future, nature and culture, and submerging birth in death, the commodity is hardly a sign or symbol. Only in religion and magic can we find equivalent economies of meaning and practices of expenditure in which an object, be it a commodity or a fetish, spills over its referent and suffuses its component parts with ineffable radiance. (233)

If we narrow the "commodity" down to musical instruments, we can understand the deep cultural meanings that even experimental instruments might have for my interlocutors. William Stahl notes that as new technologies age, the "magical" language once used to describe them can become "less pronounced and more an invocation of already established meaning" (1995, 254). I contend that DIY music technology escapes this trend twofold: first, as an always-emergent experiment that refuses to lose its luster; second, if we follow my assertion that this is a post-digital practice, capable of fusing the analog, the digital, and beyond in ways at once forward-thinking and self-consciously antiquated, Taussig's outmoded technologies apply here, as well. In other words, the co-dependence of technology and magic that flouts modern Western rationality vastly complicates our engagements with science. As I show below, these tensions between science, pseudoscience, and the demarcations of life continue to fascinate both social and artistic thought.

Defining Concepts in DIY Music Biology, From Life Forms to Forms of Life

Thus far in this chapter, I have explored the relevance of new advances in amateur life sciences for music technology. As I argued in chapter 1, DIY music technologists struggle with the utilitarian value of artistic *play*; here, I have argued that, by exalting the value of experimentation in the midst of a pressure to professionalize oneself, DIY music technologists and DIY biologists turn improvisatory play into a form of citizen science. That is, they push themselves into realms where they are not experts, but where some degree of scientific knowledge lends itself to a desirable aesthetic realm. I have showed that they do so via a bewildering array of workshops, lecture-demonstrations, performances, exhibitions, and online media, and through which tinkerers experiment but also strive to make a living.

In the discussion, two terms emerged as key for understanding DIY music biologists: citizen science and pseudoscience. First, let us take a closer look at the former. Varied definitions of "citizen science" abound, but the term typically denotes crowd-sourcing amateur contributions to a scientific research project led or encouraged by experts. In perhaps the most common recent usage, it is "a research technique that enlists the public in gathering scientific information" (Bonney et al. 2009, 977). Perhaps the best-known organized center for citizen science, the Cornell Lab of Ornithology, states:

> The term "citizen science" has been used to describe a range of ideas, from a philosophy of public engagement in scientific discourse to the work of scientists driven by a social conscience.
>
> In North America, citizen science typically refers to research collaborations between scientists and volunteers, particularly (but not exclusively) to expand opportunities for scientific data collection and to provide access to scientific information for community members. (n.d.)

The lab further debates these descriptions in an accompanying pamphlet, establishing the stakes for agreement on a definition (e.g., credibility, funding) and asking: Is this "a genuine revolution in science?" "Is 'Citizen Science' the right term," given the "nationalistic connotations of 'citizen'?" "Is a definition even necessary?" They conclude that "it may be most appropriate to explore different models of citizen science" (2007). In such broader interpretations, citizen science is "knowledge production by, and for, nonscientists" (Ottinger 2010, 245) that is part of "nonscientists' critical engagement with science more generally" (248). It is both "a science which assists the needs and concerns of citizens" and "a form of science developed and enacted by citizens themselves," leading to "the 'contextual knowledges' which are generated outside of formal scientific institutions" (Irwin 1995, xi).

DIY music technology meets most of these criteria, but it does not generally meet the narrowest definition of volunteer-based data collection in the service of a larger, professionally-run project. In other words, there is one key difference: DIY music technologists do not necessarily contribute to collective, organized research but rather explore scientific learning as individuals seeking to expand their artistic craft. We might say that they *mine* science for aesthetic inspiration. Their contributions, in turn, involve a reciprocity of creativity, design, knowledge, and inspiration: bestowing sounds and instruments upon listeners while (re)presenting scientific principles in imaginative forms. As a result, they strive to connect with an audience in order to broaden the audience's knowledge about the world, while pushing the limits of their understanding in order to get to know themselves more deeply; they do so by experiencing music from the perspective of the "Other," the scientist.

As for "citizen," the narrower characterizations of citizen science frequently draw on the word "volunteer" to describe the role of the participant, in addition to "public," nonscientist," "avocational," and so forth.[128] How has *citizen* come to be conflated with

[128] Likewise, the term "citizen" is applied to fields such as journalism and history to denote contributions by interested, engaged amateurs. "Participatory media" is the broader, longer-standing heading for this type of activity, under which community radio,

volunteer in this context? In the liberal-democratic conception, "citizenship is a society's legal recognition of the democratic equality of all its members. A citizen, correspondingly, is an autonomous subject entitled to exercise certain rights and expected to fulfill certain obligations" (Olson 2008, 40). In describing the construction of the modern citizen, Immanuel Wallerstein lists a number of binary distinctions that include or exclude one from citizenship and undermine the equality presupposed by it, including "educated and ignorant, skilled and unskilled, specialist and amateur, scientist and layman, high culture and low culture," as well as "the ur-category which all of these others imply—civilized and barbarian" (2003, 652). The further implication is that education can transform someone from a passive, or potential, citizen into an active one. Through "voluntary, active *self*-government" emphasizing the "ethical dimension" of citizenship, Kevin Olson explains, "By engaging the practices expected of citizens, people acquire the habits and dispositions of citizens and in a very real sense become such" (2008, 42).

I believe this focus on ethics and voluntary action sheds light on the relationship—often, the tensions—between DIY music technologists and their creations. The conception of a citizen as a responsible, engaged member of society highlights the sense of duty felt by many DIY music technologists (as well as the Makers of chapter 1) to expand their knowledge about science and technology. Furthermore, "DIY citizenship" has emerged as a new category in the wake of the Maker Movement; terms such as "active," "engaged," "sovereign," and "distributed" are often mentioned, but its definition is not yet agreed upon (Ratto and Boler 2014). Overall, the discourses surrounding

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blogs, social media, wikis, and so forth also fall. Each field is ensconced in its own discourse about the nature and ethics of public participation.

citizenship, and thus citizen science, force us to question: *Who* can be a scientist (or likewise, an artist)? When does a given activity *count* as science? What happens when non-experts contribute to science or interpret scientific phenomena? The obsession that Powers's protagonist in *Orfeo* has with the notion of a virus is not misplaced, then, but rather central to the intersections between DIY biology and music technology.

These questions also speak to the variable definition of *pseudoscience*. Whether a reference to "false" science or to work that resembles, but is not truly or not quite, science (formulated as magic, the occult, or non-science, among other terms), researchers routinely encounter interpretations and applications of science that complicate this term. When citizens (as avocational, non-professionally-trained scientists) are involved, can we be sure that their work is ever scientific? Furthermore, will history alter the boundaries for inclusion as scientific thought, as it has over many paradigm shifts before? Literature from science and technology studies would argue no and yes, respectively (Latour 1993; Bijker, Hughes, and Pinch 1987). The question of whether the science practiced by DIY music technologists is "true" is not the right question to ask here. The experimental endeavors of DIY music technologists often flout these definitions, and, I would argue, their purpose determines their relation to science. If the goal is to use the principles directly for social good, as with Martin Howse's DIY Geiger counters, concern for scientific accuracy is of utmost concern; otherwise, loose, aestheticized, even *magicalized* interpretations of these principles are accepted or even encouraged, with an emphasis on creative process over verifiable results. But even then, these domains remain indistinct, as science and art can resist formulaic boundaries.

Next, the concept of "synthetic" arises. The most apt analogy I have found between this combined approach to DIY biology and music is with synthetic biology, the design and construction of biological entities not yet in existence—a "fundamental redesign of life" (Douglas and Savulescu 2010, 687). DIY music technologists are not scientists by training and are not necessarily accurate in their interpretations of science (although some are, and moreover, some are biologists by training, such as NK Projekt's co-founder Farahnaz Hatam), yet they employ biological metaphors at an astounding rate. I see this field as a scientific counterpart for DIY music technology due to a number of parallels between their fundamental concerns:

1) **construction of new materials**: at its core, synthetic biology is supposed to construct new biological parts, devices, and systems
2) ***re*-construction of existing materials**: synthetic biology can also change biological designs in order to experiment with, extend, or improve upon the original
3) **concern for ethics**: the ability to create new life forms is taken with utmost seriousness
4) **care for aesthetics and process**: design and engineering are of utmost importance; synthetic biologists are likened to skilled craftsmen

Moreover, synthetic biology is popular among DIY biology spaces like Brooklyn's Genspace, which regularly runs short courses on topics such as "Intro to Synthetic Biology" and "Biohacker Bootcamp." Matt Ulgherait, a biologist and musician who dabbles in circuit bending, explains that a key practice of DIY biologists is building and bending biological circuits: "This is the same kind of community [as DIY music technology], but with a much more complicated goal. It's analogous to circuit bending, but this is for an organism." Indeed, in numerous descriptions of synthetic biology, the term *circuitry* is emphasized.

As synthetic biology becomes more standardized and its methods streamlined, biological *components* have also arisen, akin to the resistors and capacitors that are the building blocks of electronic circuits. Ulgherait points to the relatively new tool BioBricks as comparable to the Lego-like educational electronics-building components littleBits (discussed in chapter 1). BioBricks are open source DNA sequences separated into discrete, interchangeable "parts" (e.g., promoters, terminators) that can be "assembled" into larger systems that facilitate biological functions and incorporated into existing cells—circuits of human design that both mimic and alter microscopic pieces of natural life.[129] Even DIY "kits" are also available, including a "Virus Construction Kit" of components used for viral gene therapy.[130]

This connection between biology and anthropology has led me to consider the juxtaposition of the terms *life forms* and *forms of life*. In the broadest sense, a life form presently refers to anything that is considered to be alive, as well as the characteristic form of that living thing at its maturity. But, as biologists acknowledge, the factors that determine what we view as "alive" are vulnerable to interpretation. As previously noted, a virus is not technically alive, though it is often reified as a living, active entity. Synthetic biology poses new challenges, as it enables "the creation of entities which fall somewhere between living things and machines" (Douglas and Savulescu 2010, 688). We

[129] BioBricks are not as widely adopted as its creators had hoped. Biologists do currently use discrete DNA sequences with specific functions, but these are generally not referred to as BioBricks.

[130] Student researchers in Freiburg, Germany created this kit for a 2010 competition held by the International Genetically Engineered Machine (iGEM) Foundation, founded at MIT in 2003 and now a separate entity in Cambridge, MA. Their results can be found at: http://2010.igem.org/Team:Freiburg_Bioware. Such "virus kits" have been available to biologists for over a decade, but a high level of expertise was needed to use them.

see this concern in musical domains, as well, with questions of technology and the body, extended techniques in performance, and instruments as prostheses.

According to Stefan Helmreich and Sophia Roosth (2010), the very idea of a life form emerged from the nineteenth-century German word *Lebensform*. Early definitions of the term were indistinct and open-ended yet imbued with the "materialist vitalism"[131] of the times, as well as with Kant's integration of aesthetics with form; in other words, these life forms were "aesthetic, self-determining, and teleological" (31-32). Life forms followed a winding path, historically, culturally, and linguistically, later standing in for extraterrestrial beings in science fiction novels and, eventually, the *life* of *form*. From about 2004 onward, synthetic biology has pressed an important shift in this trajectory, as the potential to build new and varied life forms from scratch injects ambiguity into our very notion of *life* itself. Citing this field as an example, the life form of today, write Helmreich and Roosth, is "future-oriented, even hopeful" and often "underwrites a *constructive* approach to vitality" (28). What has remained intact about the concept of a life form over time is "a space of possibility within which life might take shape" (27).

Anthropology (as well as philosophy), meanwhile, is sometimes said to study *forms of life*, meaning the make-up of various cultural entities. The initial use of this phrase comes from Wittgenstein, who also used the word *Lebensform* (which we might consider to hold a family resemblance, in his terms, of overlapping similarities to the biological usage). Since he used the word sparingly in his *Philosophical Investigations*, much debate has endured over Wittgenstein's exact intentions. But two meanings can be

[131] Although materialism and vitalism are oppositional doctrines, when combined, they indicate a focus on the scientific matter that makes up the material world that also allows for a belief in the soul or spiritual energy that might inhabit life forms.

ascertained, according to the Stanford Encyclopedia of Philosophy (Bileztki and Matar 2014): "Forms of life can be understood as changing and contingent, dependent on culture, context, history, etc; this appeal to forms of life grounds a relativistic reading of Wittgenstein. On the other hand, it is the form of life common to humankind, 'shared human behavior' which is 'the system of reference by means of which we interpret an unknown language' (*PI* 206)".[132] Alexander von Humboldt extended *Lebensform* to refer to customs within a culture, which Helmreich and Roosth take to mean a form or "way of life," while also taking aesthetics into account by "[bringing] into play the habitual, the environmental conditioning of form, pulling aesthetic abstractions down to earth…." (2010, 33).

Predating the concept of *Lebensform*, the machine, device, or instrument became a critical intermediary between nature and art during the Renaissance, built at once in mimicry of observations about the natural world and in hopes for what it might reveal about nature. The resulting form of machine was a complex blend of poetry, skill, and myth, among other influences—but ultimately a synthetic, artificial rendering of nature, despite any usage of natural materials (Sawday 2007, 1).[133] Jonathan Sawday argues that when modern theorists of technology display a concern with the erasure of boundaries

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[132] This citation refers to page 206 in the 4th edition of *Philosophical Investigations*: 2009, P.M.S. Hacker and Joachim Schulte (eds. and trans.), Oxford: Wiley-Blackwell.

[133] Although Sawday addresses the need to overcome impositions placed by nature on human life, he does not explicitly address theories that allow for non-human agency. The closest he comes is as follows: "Acting upon the world, their avowed purpose was to make human existence more tolerable. But fabricated as they were out of a synthesis of poetry, architecture, philosophy, antiquarianism, and theology, as well as craft, skill, and design, Renaissance machines were also freighted with myth, legend, and symbolism. As products of human activity concerned, according to Aristotle, with 'bringing something into being,' machines were manifestations of artifice rather than nature" (2007, 1).

between nature/artifice, human/machine, biology/technique—cyborg theory and so forth—they owe more than they realize to the legacy of Renaissance anxieties about human life and technology (313). With this in mind, we see again the weight that musical instruments carry, in the depth of their histories and breadth of their meanings. When sound technologies become meditations on *life* in and as *form*, our instruments reflect our *biophilia* all the more.

Conclusion

In *Emergent Forms of Life and the Anthropological Voice*, Michael Fischer takes up what he views as Wittgenstein's claim for a "sociality of action that always contains within it ethical dilemmas" in light of new biotechnologies (2003, 10).[134] As we have seen in this chapter, forms of life connect with life forms *and* new technologies through experimentation—with science, music, social relations—to consistently challenge notions of what these domains should entail and how our actions can, or should, reflect our ethical and artistic priorities. DIY music technology, framed here as an extension of citizen science, harnesses precisely this experimental impulse, tinkering with new technologies or reorganizing older ones in order to re-enchant our sonic imaginations, employing tropes of the virus and contagion especially well in this regard. This synthetic approach combining the non-expert interpretation of scientific and not-so-scientific principles melds art and ethos to resolutely chip away at the encased black box of what it is we think we know, one event and one instrument at a time.

[134] For Fischer, biotechnology can include "new life-forms, cyborgian, hybrid cross-species; nano-technologies and new materials" (2003, 9).

Chapter 3

The Sounds of "Zombie Media": Waste and the Sustainable Afterlife of Repurposed Technologies

Figure 23. Vendor sign at Maker Faire 2014:
"Desconstruction → Production → Revolution
DIY || DIE"

DIY Recycling and "Conspicuous Production"

In chapters 1 and 2, I analyzed instances in which DIY music technologists demonstrate their value as productive citizens through the utilitarian endeavors of the Maker movement and as citizen scientists contributing to biological discourses; I showed that DIY music technology facilitates a cultural citizenship based on an anti-consumerist stance (albeit an inconsistent one) and a way of *becoming* as a transformation forged through the building process. In this chapter, I explore the operation of these ideologies in more detail by looking at one specific kind of DIY practice, "recycling," as well as its myriad permutations (reusing, repurposing, repairing, rescuing, reclaiming, salvaging, mending, and so on).[135] I am concerned with questioning what DIY recycling *does* and whom it benefits: DIY musicians recycle physical materials while engaging a broader mindset about the value of "making do" rather than making *more*; in what follows, however, I show that DIY recycling nevertheless embodies contradictions in the Maker Movement (and beyond) about waste, particularly the issue of whether the act of making new inventions is necessarily beneficial.

Given the social value placed on recycling rather than discarding used materials, my interlocutors view the practice, in its broadest form, as a sign of responsibility and care for one's community and environment. But two more motivations are also present. First, the ability to envision and craft new inventions from old materials showcases one's technical mastery and ingenuity. Second, recycling as a form of repair allows DIY music technologists to opt out of the rampant consumerism and planned obsolescence they find distasteful and inadequate.[136] Taken together, we may call this the "MacGyver-meets-grandmother effect": my interlocutors' recycling demonstrates their social value through cleverness and resourcefulness.[137] I argue that what these musicians have in common is a

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[135] Note the frequency of the prefix "re" in the linguistic conceptualization of these practices, indicating both the repetition ("again," "anew") and reverse "backward" of action.

[136] To use a fashion analogy, I equate this approach to revamping an outdated thrift-store outfit, having an eye for vintage where others see only junk. I equate recycling-as-repair with mending a torn shirt rather than purchasing a new one, as many are wont to do in the age of cheap "fast fashion."

[137] Secret agent Angus MacGyver was the main character on the eponymous 1980s-1990s television show, known for his ability to solve crimes with a mix of grit, technical mastery, and resourcefulness with everyday objects. The phrase "to MacGyver"

tendency to invest in recycling's benefits for the environment in order to validate their roles as productive, responsible citizens. I mean this not in a cynical way, though some *are* interested in merely aestheticizing environmental themes. DIY music technologists—like experimental musicians of all sorts—are well acquainted with questions about their projects' usefulness.[138] Rather, I contend that, consciously or unconsciously, recycling is a key way for DIY music technologists to fight against the critique that what they do is self-indulgent.

In probing this argument, this chapter provides cases that display various entry points for understanding recycling as a practice in the DIY music technology community. In particular, I explore the "e-waste" phenomenon, or the rampant global problem of dangerously discarded electronic devices, which my consultants confront by rescuing old or obsolete materials otherwise destined for the dump. The practice of circuit bending, discussed widely in this dissertation, is likewise a form of recycling at its core (and it, too, will appear in this chapter). Other tools and techniques include repurposing old speakers as battery-powered amplifiers, "rescuing" beaten-up electric guitars and retrofitting them with hacked circuits, scavenging boxes and sound-producing paraphernalia to create experimental instruments, providing record-buyers with decorative seed pods instead of plastic albums. These cases, I will show, engage discourses about "freeganism" (rescuing food from dumpsters), the value of amateurism versus mastery, the aura of material objects (e.g., the joy of owning tactile memorabilia

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something entered popular culture to express a process of ingeniously improvising a technical solution from unexpected or leftover materials.

[138] See chapter 1 for an example of this within the context of start-up technology ventures.

like a vinyl album or a novel instrument), and the merit of arts practices like "glitch," which emerge from the graveyards of once-new media. In sum, I show that through their repurposing activities, DIY music technologists mobilize a discourse on "environmental sustainability" even when they do not engage with nature *as such*, and when they use materials not typically considered by environmentalists (such as audio speakers).

Media theorists often stress the "residual" nature of new media technologies, which hold both physical and cultural vestiges of the past (e.g., Acland 2004; Marvin 1990; Sterne 2012). According to Garnet Hertz and Jussi Parikka (2012), new media is never truly new and old media never truly dies—a phenomenon they call "zombie media": "dead media, revitalized, brought back to use, reworked" (425), or "resurrected to new contexts, uses, and adaptations" (429). Attending to zombie media calls forth different temporalities than those emerging from a notion of technological development as a linear progression, where new phases out the old. "Assembled into new constructions," Hertz and Parikka assert, "such materials and ideas become zombies that carry with them histories but are also reminders of the non-human temporalities involved in technical media…[and tap] into the temporalities of nature—thousands of years of non-linear and non-human history" (429).[139] In their estimation, there are two alternatives for a physical material used in media technologies: "It either stays in the soil as residue and in the air [left to decay], or is reappropriated through artistic, tinkering methodologies" (430). In their case study of circuit benders (as a subset of DIY-ers, hobbyists, and amateurs), they view participants as archivists and media archaeologists,

[139] They are taking their cue here from Manuel De Landa's *A Thousand Years of Non-Linear History* (1997).

breaking into the black boxes of undead media artifacts to excavate art, knowledge, and cultural history.

By playfully conjuring, commenting on, and re-presenting temporalities through their use and construction of zombie media, DIY music technologists complicate what Mackenzie and Wajcman (1999, 19) call technology's "path dependence": that "the history of technology is a path-dependent history, one in which past events exercise continuing influences. Which of two or more technologies eventually succeed is not determined by their intrinsic characteristics alone, but also by their histories of adoption" (cited in Lysloff and Gay 2003, 16, in the context of music technology).[140] DIY repurposing adds a new layer of complexity to this narrative, as it tends to illuminate failures, it revisits machines that lacked mainstream adoption, and it focuses on exposing or creating glitches in old technologies.

In what follows, I situate DIY repurposing practices—their engagements with and construction of zombie media—within a context of "conspicuous production,"[141] that is, the tendency for DIY music technologists to obsess over constant production and invention, at the same time they appear to embrace discourses of environmentalism and sustainability. To begin, let me steer us to my own introduction to "e-waste" as artistic practice, at Berlin's esteemed Transmediale festival. I will then explore the network of participants radiating outward from the people and themes associated with that event,

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[140] The Moog synthesizer is one example of such a "path-dependent" music technology, in that it includes residual media (a keyboard) in a new technological context (the electronic synthesizer), and it was popularly adopted over the less intuitive form of the competing Buchla synthesizer (Pinch and Trocco 2002).

[141] I credit Brendan Byrne for this phrase (a pun on "conspicuous consumption"), which he mentioned casually at a gathering held by Phillip Stearns, to describe the act of making for making's sake (in a pejorative sense).

focusing largely on my longtime interlocutor, Phillip Stearns (who surfaces repeatedly at such events, perhaps more than anyone else I have met), and an array of related vignettes selected from many throughout my fieldwork.

Transmediale and the Art of E-Waste

The cusp of February in Berlin is notorious for its short days and bleak weather, but it is also a time that brings about some of the city's most noteworthy annual events: the Berlinale international film festival; Transmediale, once a Berlinale offshoot and now a genuine occasion in its own right, which covers the nexus of media art, technology, and culture; and CTM (Club Transmediale), the younger sibling of Transmediale and a "Festival for Adventurous Music and Art."[142] The festivals bring together international artists, musicians, and critics in an eclectic array of exhibits, installations, performances, workshops, lectures, and roundtable discussions that "aim at fostering a critical understanding of contemporary culture and politics as saturated by media technologies" (Transmediale.de). Here, I will focus on the main Transmediale segment, which I

[142] An early version of Transmediale began in 1988 as VideoFilmFest, an offshoot of the "International Forum of New Cinema," the section of the Berlinale (Berlin International Film Festival) that screens its most experimental works. VideoFilmFest privileged entries on video—then a fledgling form of artistic expression—but later split from the Berlinale and reinvented itself as Transmedia in 1997 and finally Transmediale in 1998 to reflect an interest in broader forms of media art (Transmediale.de). 2001 inaugurated the start of its annual themes targeted for critical reflection, from that year's "Do It Yourself!" through 2015's "Capture All." Invited participants and general public combined, Transmediale now estimates an average of 20,000 visitors per year at its current host site, the der Kulturen der Welt (House of World Cultures). Club Transmediale began in 1999 with a focus on electronic music and club culture; it expanded into the broader "adventurous music" domain since at least 2006, with the name change occurring in 2011, and takes places across multiple Berlin venues (CTM Festival 2015).

attended in late January to early February 2013, due to its DIY roots[143] and its embrace of recycling as an art form; in fact, even the location itself, in Berlin's Haus der Kulturen der Welt, displays an ingenuity of architectural recycling.[144] In particular, I am interested

[143] Readers might be interested to note Transmediale's explanation for the choice of "Do It Yourself!" as the initial theme: "The introduction of new electronic and digital media has regularly gone hand in hand with the promise that their users will become active producers. This applies to Brecht's radio theory as much as it does to the development of video as an alternative to expensive film and television productions in the 60s and 70s, and to the camcorder and Internet revolutions of the 90s. While these hopes have only ever been fulfilled in part in society as a whole, the availability of new, affordable digital equipment has fostered a lively DIY scene over the past 10 years. This has provided a growing number of people with an opportunity to develop, present and distribute their own media productions themselves and even to create their own media tools. The transmediale.01 focuses on media developments and artistic projects in which visitors become users or producers even. The pioneers of this active appropriation of digital technology are the DIYers and hackers who open up, convert, extend and misuse computers, projectors and all sorts of electronic household equipment as well as software packages. This DIY approach is now increasingly assuming the form of a cultural movement in which small artistic groups put their video clips on the Internet, fans of computer games design their own levels, and DJs and VJs develop software in international networked groups and through an open exchange of material. The exhibitions, presentations, workshops and live events at the transmediale.01 concentrate on artistic projects which are concerned with the DIY development and construction of creative tools and which are designed to foster creative media competence." ["Transmediale.01 DIY (do it yourself)." This link remains active as of May 8, 2015. http://pastwebsites.transmediale.de/01/en/diy.htm.]

[144] Though the fascinating history of this building is too tangential for this chapter in full, I will summarize the relevant background here. The Haus der Kulturen der Welt is a conceptually and historically significant building located in the Tiergarten, Berlin's largest city park, adjacent to government buildings. It was originally the site of the Zeltenplatz, a public gathering space for entertainment and political debates, until its destruction during World War II. An American architect, Hugh Stubbins, designed a *Kongresshalle* (Congress Hall) for cultural exchange as the U.S. entry into Berlin's International Architecture Exhibition in 1957. The Tiergarten was part of West Berlin at that time, and the *Kongresshalle*'s upwardly curved design, raised on an artificial mound, was meant to "serve as a symbol and beacon of freedom with its message reaching the East" and convey "the promise that there would be no restrictions on the freedom of intellectual work" (official discussion of the site's architecture available at http://www.hkw.de/en/hkw/gebaeude/gebaeude.php). (Colloquially, Berliners refer to this design as the *Schwangerer Auster*, or "pregnant oyster.") Cultural events with a transatlantic focus were always of particular interest (including John F. Kennedy's

in the work of a group of conceptual artists who employ "e-waste" as their area of expertise.

Transmediale's theme that year was "BWPWAP: Back When Pluto Was a Planet." Referring to Pluto's 2006 demotion from planetary status and its subsequent nostalgia within popular culture, the topic covered "things in our recent past that have changed quickly," on the basis that "this classification crisis, spurred on by new technologies and shifting knowledge paradigms, opens up a rich space of cultural negotiation and artistic intervention."[145] With this understanding in mind, I wandered through the monumental building's large-scale exhibitions, sat through talks and performances, and observed workshops over the course of the multiple-day festival.[146]

Notable participants included Phillip Stearns, one of my interlocutors from New York, and Peter Edwards, a New York-based circuit bender and instrument designer who performs and sells his wares as Casper Electronics, having relocated to Europe in order to complete a graduate degree at STEIM (Studio for Electro Instrumental Music) in

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famous 1963 visit), and when the building was finally restored in 2007 (following an earlier renovation after a roof collapse in 1980, after which it re-opened as the Haus der Kulturen der Welt) it was christened with an interdisciplinary festival reflecting on the city's relations with New York, called "New York on the Spree" (Tzortzis 2007). Today, hosting an event there confers considerable cultural importance—as well as the benefit of national arts funding—a distinction that Transmediale has been able to claim since its first occasion on site in 2002.

[145] "Transmediale 2013 BWPWAP." http://transmediale.de/ past/2013.

[146] In retrospect, the scene suggests another reflection on and revision of the World's Fair perhaps as much as New York's Maker Faire. Transmediale's frenzied blend of DIY technology, aspirational "high art" from the multimedia art world, and incisive, sometimes aggressive cultural critique, all taken together, composed a complementary take on retro-future concerns with a more sophisticated (and less child-friendly) flair.

Amsterdam.[147] Here, I will focus on Stearns's unique contributions to the art of repurposing in DIY music technology—especially the loose genres of circuit bending and glitch.

Stearns and Edwards were invited to Transmediale as part of the "ReFunct Media" installation, which was prominently displayed in the lobby of the Haus der Kulturen der Welt. Its mesmerizing components flashed, whirred, and buzzed continuously: outmoded televisions, printers, CD players, video cameras—dissected and clinging to life, their guts spewed and displayed to the world, resurrected and automated with the help of Arduinos. The installation was the brainchild of European artist-researchers Benjamin Gaulon (from France) and Karl Klomp (from the Netherlands), whose artist bios describe their approaches in such terms as "hacking," "recycling," "circuit bending," and exploring technological "limits and failures." Other participants included Tom Verbruggen and Gijs Gieskes (both from the Netherlands). Gaulon and Klomp position their festival entry as follows:

> Voluntarily complex and unstable, "ReFunct Media" is an installation that *experiments and explores unchallenged possibilities of "obsolete" electronic and digital media and our relationship with technology and consumption*. Rather than merely dealing with e-waste, and sustainable design strategies, it aims to re-contextualize second-hand hardware or cheap toys, and to transform commercial and mass-produced technology (such as Minitels and TVs) into unique devices, with potential for new and original means of expression or communication.
>
> The development of the ReFunct Media #5 installation for transmediale

[147] Other STEIM connections in my research include alumnus Nicolas Collins, who wrote the highly influential book *Handmade Electronic Music* (2006), referenced by a large number of my interlocutors, and the Standuino members of chapter 1, who traveled there to conduct workshops on their microGranny and fraAngelico instruments in 2013. Another former Transmediale contributor not present in 2013 was Martin Howse, whose work on the micro_blackdeath noise synthesizer is detailed in chapter 2.

> 2013 started in August 2012 by hacking a very iconic device: the French Minitel, a Videotex online service accessible through the telephone lines. During the summer workshop, participants became familiar with basic hardware hacking and circuit bending, working with a just-proclaimed-dead device, as the Minitel network has been closed for good.
>
> ReFunct Media #5 plays with the limits of planned obsolescence and the *short lifespan* of digital technologies. The *planned death* of digital devices causes a rapid decrease in the economic value of existing electronics. Although the value of obsolete electronics approaches zero, their components can still be useful in other contexts. Deconstructing and recycling readily available, cheap, electronic devices into creative tools is more than a lot of fun. The process offers the same visible, *hands-on learning and understanding acquired through dissection*. (Transmediale 2013; emphasis mine)[148]

The "hands-on learning and understanding acquired through dissection" occurred on Thursday morning, when Transmediale hosted an "E-waste Workshop" by the same collaborators.[149] E-waste refers to discarded electronic devices, often left in dumpsters in various stages of "broken," due to planned obsolescence or simply a consumer who tired of them. These might also be resurrected from thrift stores, basements, parts stores, or websites for used items such as Ebay or Craigslist. Participants were asked to scavenge devices they hoped to repurpose as art, using them as "raw material" for "hacking/recycling."[150] The tools and techniques used would be roughly the same as for the installation, albeit targeted towards beginners.

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[148] "Refunct Media #5." n.d. Accessed January 29, 2015. http://www.transmediale.de/content/refunct-media-project-minitel-hacking-0.

[149] Edwards was not present but was scheduled to run a synthesizer-building workshop at Transmediale the following day.

[150] Documented on the Transmediale 2013 event page: "E-Waste Workshop." Accessed January 29, 2015. http://www.transmediale.de/content/e-waste-workshop.

Figure 24. ReFunct Media #5:
Audiovisual Installation at Transmediale Opening 2013

Although the workshop quickly filled up with pre-registered participants, I was allowed to attend as an observer over the course of the next few hours.[151] As is customary at such events, the participants briefly introduced themselves, citing their reasons for

[151] A number of professional photographers also fluttered in and out, showcasing the high-profile nature of the festival. Although not entirely unexpected, I felt that this activity (myself included) made participants more self-conscious and hesitant, as they

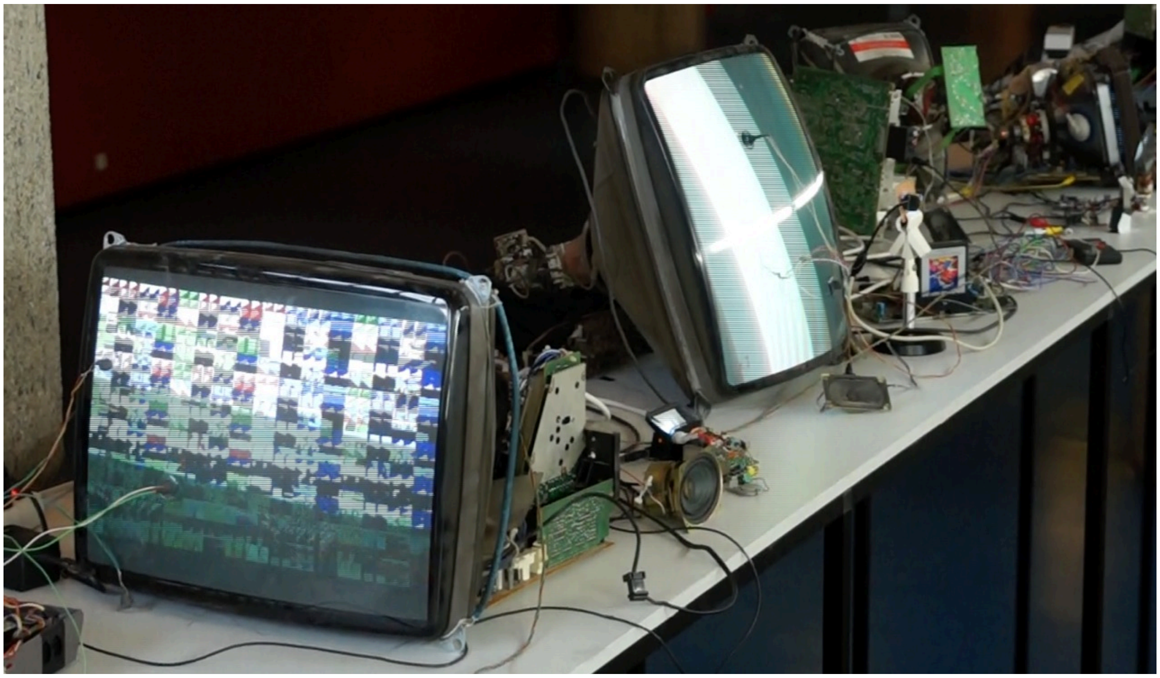

Figure 25. Video Still of ReFunct Media #5 Installation

Figure 26. Video Still from E-Waste Workshop

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constantly had cameras over their shoulders while exploring a potentially intimidating new skill.

attending the workshop and naming the equipment they brought. In this case, they hailed from a variety of European countries, most were visual artists or scholars simply curious about the topic, and they displayed an array of scavenged materials: printers, cell phones, CD players, Game Boys, digital cameras, old toys, and even an old GDR-era (East German) radio found at a Berlin thrift store.

Initially, I found the set-up disappointing. Unlike most of my previous workshops, there was little in the way of a conceptual introduction, and it lacked common elements such as printouts containing technical information, clear step-by-step instructions, or explanation as to how we would work on developing a tangible skill set. In other words, there did not seem to be any planned learning objectives. Gaulon began with a terse greeting ("I suppose you know who we are from the website…") and announced that the group would go through the process together, trying to build a "network of devices…sharing signal or power…to generate sound or images," just as in the installation. The organizers hovered about, and, as participants slowly opened and explored their devices, they explained individually which of the devices' aspects might be hackable, assisting in early stages of the process. By the end, it was unclear whether much individual progress was made. Certainly, the stated goal to "create a completely new project by the end of the workshop, from concept, design, and electronics to interfacing"[152] was not met, since participants left without completing any projects. I hoped, however, that their curiosity was piqued, as mine was, as to the possibilities for recycling electronic materials as art.

Beyond this workshop, the fate of e-waste is an increasingly pressing topic. In

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[152] Ibid., "E-waste Workshop" event page

fact, an e-waste ban went into effect in New York City for 2015, at the risk of $100 fines per item tossed into the trash. The Department of Sanitation calls these items "covered electronic equipment," and they are set to be required to be returned to manufacturers or retailers under the state's Electronic Equipment Recycling and Reuse Act (NYC Department of Sanitation 2015). In addition to more obviously outdated devices, the ban includes broken or unwanted phones, computers, mp3 players, cable boxes, and more. New York is far from alone, as twenty U.S. states currently have landfill bans in place (Electronic Recyclers International 2015). The Environmental Protection Agency (EPA) explains that many of these devices can turn into hazardous waste, leeching dangerous chemicals into the environment if not disposed of correctly (U.S. Environmental Protection Agency 2012). When the time of disposal (or recycling) has come, the EPA calls this process "end-of-life management" (ibid.), implying that devices should be carefully prepared for their impending deaths or resurrections.

Following this thoughtful (if unintentionally humorous) approach that anthropomorphizes electronics, I invite readers to consider during the next sections of this chapter what a *gerontology*—as in the study of aging—of musical instruments and other sound-producing equipment might look and sound like. As Elliot Bates points out, all instruments have a life cycle, from a proto-birth to an afterlife. He implores us to study their later stages from perspectives beyond preservation and entombment in the pages of books and the halls of museums: "One of the affective powers of instruments is their ability to continue to enchant subsequent generations, even when instruments no longer sound and are contained within protective cases" (2012, 389). Let us explore how one might care for dead and dying sonic materials, as our approaches to their end-of-life management and potential resurrection can be illuminating.

Phillip Stearns in New York: Bending, Hacking, Glitching

The E-waste workshop was a particularly straightforward example of a larger phenomenon in DIY music technology: the reuse and recycling of materials. Once I learned to look for it, I realized that this concern underlies most of my fieldwork to varying degrees. I turn next to further work by Phillip Stearns as a connecting thread between New York, Berlin, and various modes of conceptual and physical engagement with sustainability.

I first encountered Stearns at the circuit bending-oriented Bent Festival in 2009, where he performed a solo set with body-controlled sensors and sounds as Pixel Form.[153] By 2011, he was curating the festival himself, which had relocated to the venue 319 Scholes in Bushwick, Brooklyn (named after its address). At the time, Bushwick was steadily transforming into an arts-centric neighborhood in its own right, luring musicians and artists a few stops farther out on the L train from Manhattan, passing the rapidly-gentrifying Williamsburg on the way.[154] Stearns's own temporary artist studio was a few blocks away, which I visited shortly after the festival.

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[153] The 2009 Bent Festival took place at the Tank, a venue in midtown Manhattan, which later closed due to rising rents. See Flood 2010 for more details about this event. In 2010, it moved to DUMBO, Brooklyn, where Stearns displayed an installation. It moved again to 319 Scholes the following year, which would be its last.

[154] In a few-block radius, one could visit 319 Scholes, 3rd Ward (discussed in chapter 1), DIY music venue Shea Stadium, and a number of artist studios and rehearsal spaces. With the exception of 3rd Ward, all locations blended into the façade of grim warehouses that characterized most of the neighborhood.

Stearns embarked on this trajectory by combining an interest in physics and audio engineering, which led to an undergraduate degree in the latter and then a graduate degree from the California Institute of the Arts. Initially a guitarist, he later discovered the software program Pure Data (an open-source alternative to a popular visual programming software for music and multimedia called Max/MSP), as well as circuit bending. In a 2011 interview, he told me that his move to New York in 2009 was prompted by the lack of audience and community for the kind of practices I group together as DIY music technology; back west, he would search online for workshops but found none in Denver and few in California. Stearns first got involved with the Bent Festival in 2007, which exceeded expectations in New York, while trial offshoots in Los Angeles and Minneapolis were less successful. New York seemed the place to be, due to the frequency of related festivals and workshops to teach and learn from. "There is a sense of community that happens around festivals," he explained. "Online forums [alone] are not really a community." And as for workshops, the "teachers are a core group," leading to networking and employment opportunities. The value of New York's scene for networking would prove true in the case of Transmediale, for example; acceptance to the festival is notoriously competitive, but Stearns was invited to be part of the ReFunct Media and E-waste projects after coming to Benjamin Gaulon's attention locally.

Circuit bending would prove a crucial intermediate step for Stearns, connecting his background in recording technology and experimental music performance to e-waste and later projects. As Hertz and Parikka analyzed (2012; see also Flood 2010), circuit bending centers on opening black boxes, salvaging old materials, reconfiguring wires, and otherwise tinkering with electronic elements previously intended for other purposes.

The focus on battery-powered devices (rather than those plugged into electrical sockets) and amateur experimentation encourages hobbyists to excavate the insides of unknown machines. This type of practice also appeals to noise musicians (and others) looking for unique modes of expression, as explained in Novak 2013: it "makes commodities into idiosyncratic junk…. In Noise electronics, circuit-bending becomes a kind of 'reverse engineering' that takes apart the objects of musical consumption and reassembles them into a new form of technological subjectivity" (165). The link between "junk" and cultural commentary appeals to DIY music technologists of many backgrounds, and circuit bending provides the catalyst and community for dipping one's toes into the pool of recycling, repurposing, and hacking as conceptual and practical artistic methods.

Hackposium: One Person's Trash Is Another's Treasure?

In summer 2011, in between Bent Festival and this interview, I attended a "Hackposium" at the arts non-profit Flux Factory, based in Long Island City, Queens.[155] Participants included Stearns, performing on a no-input mixing board, and Peter Edwards (who, as an artist-in-residence, helped curate the event), performing on a homemade synthesizer. Benjamin Gaulon Skyped in from abroad to discuss hardware hacking. Ed Bear and Lea Bertucci demonstrated the ExiTrip, a radio transmitter repurposed from outdated the iPod accessory iTrip. Indie video game builders Babycastles were also

[155] Compared to Brooklyn and Manhattan, Queens was not initially a hub for DIY music technology, although I suspect this is changing. Industrialized Long Island City has seen some overflow from those departing Brooklyn in search of more space and cheaper rent, but the most up-and-coming neighborhood is Ridgewood. Traditionally an off-the-map residential area, underemployed creative types have followed the L train through Bushwick and just past the Queens border into Ridgewood. A locally famous DIY music venue, Silent Barn, was founded there in 2005, as was a new venue called Trans-Pecos.

present, showing how to “hack” games; the trio features Kunal Gupta, a member of Bent Festival regulars The Loud Objects (see Flood 2010), who would also go on to collaborate with Death by Audio on DIY arcade exhibitions in 2014.

Most interestingly, the Hackposium combined more common forays into hacking and circuit bending with other interpretations of recycling. One approach is Stearns’s choice to demonstrate the no-input mixing board for this crowd of largely non-musicians, who appeared bewildered yet transfixed by his performance. No-input mixing boards, first cultivated as an instrument by Tokyo noise musician Toshimaru Nakamura, are becoming semi-popular tools among DIY music technologists and experimental musicians. To play the mixer as an instrument, its outputs are plugged back into its inputs, creating a feedback loop that can then be manipulated using various settings and filters. To understand the subtle ecological appeal of no-input mixers, consider Nakamura’s following quote:

> I think I find an equal relationship with no-input mixing board, which I didn't see with the guitar. When I played the guitar, "I" had to play the guitar. But with the mixing board, the machine would play me and the music would play the other two, and I would do something or maybe nothing. I would think some people would play the guitar and create their music with this kind of attitude, but for me, no-input mixing board gives me this equal relationship between the music, including the space, the instrument, and me. (Meyer 2003)[156]

Whether or not Stearns intended it as such, I believe his decision to incorporate the no-input mixer into this event reflects a holistic, sustainable, hacker-oriented approach to recycling: 1) sonically: the recycling of sound through feedback loops; 2) conceptually: the repurposing of a mixing board unintended as a musical instrument; and 3) physically:

[156] William Meyer interviewed Nakamura for the online music magazine *Perfect Sound Forever* in 2003. “Toshimaru Nakamura, Sound Student,” http://www.furious.com/perfect/toshimarunakamura.html.

taking equipment needed for live sound reproduction and staving off the need for any additional materials.

Another unusual yet plausible addition was a presentation on "freeganism" and "dumpster diving" by a member of the site freegan.info, emphasizing the "tactical use of waste items towards the enhancement of daily life."[157] "Freeganism" is a portmanteau of "free" and "veganism" (in which one abstains from all animal products, particularly in diet but also in general consumption) that is practiced through "rescuing" discarded food from trash bins—food that is often too near its expiration date for businesses to sell to consumers but is still edible. One need not be vegan to be freegan—the latter is simply a riff on a familiar term—but, in my experience, both reflect an ethical commitment to sustainable food practices and a non-wasteful, anti-consumerist lifestyle. As Kelly ErnstFriedman writes in her study of New York freegans, both groups "share a critical distrust of the current capitalist system and a desire to come up with alternatives that promote sustainability, foster individual creativity, and celebrate community" (2012, 34). I argue that this statement also applies to my interlocutors discussed in this chapter. Freeganism is well known in punk rock circles,[158] but less so in the broader music scene and hacker/Maker culture, members of which do not necessarily identify as activists for environmental causes. Freegans are often criticized or viewed as oddities for rummaging through trash by choice, despite middle-class or privileged backgrounds; many consider

[157] See the 2011 "Hackposium" event description at http://www.fluxfactory.org/events/hackposium.

[158] The term first entered my parlance through the New York and Philadelphia punk scenes circa 2004. Other oft-cited concerns among freegan/vegan/punk circles include additional forms of reuse and environmentalism, such as squatting in abandoned buildings and learning the mechanics of bicycle repair.

themselves anarchist punks or environmental activists and have renounced their former capitalist lifestyles. Likewise, this rebuke is also levied to an extent at DIY music technologists and those in the larger Maker culture, with the assumption that one must be privileged in order to have the time and inclination to engage in such activities. While the groups do not always overlap, they share a fluid notion of what constitutes "trash" and a critical relation to the production of consumer waste.

In her history of trash, Susan Strasser calls this collection of discarded materials a "dynamic category" subject to variable modes of sorting and classification: "what counts as trash depends on who's counting" (1999, 3). She notes that the latter half of the twentieth century in the West was characterized by the "veneration of newness," entangled with planned obsolescence and the marketing of disposable goods to the masses. Previously a luxury, the act of throwing goods away instead of mending or repurposing them became widespread, leaving only the poorest to root through dumpsters. But a younger, "alterative" crowd made it not only acceptable but also desirable to repurpose goods. Instead of trash, it became "thrifted," "vintage," "reclaimed." Flea markets, as well, became the height of cool, such as Mauerpark in Berlin and the (increasingly unaffordable) Brooklyn Flea in Fort Greene. As ErnstFriedman summarizes:

> While the *practice* of reusing has long been part of life among the poor and is rising among those who lost home and jobs during the economic downturn of 2008, the *act* of rescuing has undergone resurgence in popular culture. Many members of the middle and upper classes engage in the Three Rs (reduce, reuse, recycle) with a nod to irony and a touch of kitsch—clothing swaps are a great example. Thrift, including mending and recycling, has become popular again, a novelty for some, but a necessity for an increasing number of others. Rescuing and reusing has become an ideological tool that promotes racial, class, and gendered distinctions.

> Who “gets” to reuse as an aspect of identity or who “has” to in order to survive tells us a lot about our social hierarchy. (2012, 38)

“Mass Appeal” and the Cone in the Box

In a similar vein, I headed to the scraps shops of Canal Street the following summer—this time at Phil Stearns’s insistence. I had just taken an electronics class with Stearns at the now-defunct venue 3rd Ward (see chapter 1 for more on this site) and signed up to perform with him as part of a “circuit bending orchestra” for Make Music New York, an annual, day-long festival that calls for participants to meet at a certain place and time based on what instrument they would like to play. There was just one problem: there would be no amplification available outdoors, without which no one would hear our instruments over the din of city traffic. To remedy this, Stearns hosted a workshop at the audio technology non-profit Harvestworks, in which he taught the handful of participants to turn discarded speakers into battery-powered amplifiers.

I had a personal difficulty with participating in this workshop: I did not own a speaker I could part with. The quality, after all, mattered less than simply finding “a cone in a box.” As the date approached, I was still at a loss for where to find a single, low-priced speaker, so Stearns directed me to Argo Electronics—“and be prepared to haggle!” Mildly surprised that such a place would still exist in twenty-first-century Manhattan,[159] I

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[159] Manhattan once contained multiple “Radio Rows.” One was at the former World Trade Center site, for which Syd Steinhart provides a fascinating account: “Radio Row was not a neat and pretty sight. Block upon block over 300 street level stores, with over three times as many enterprises in the floors above them were jammed into 20- to 25-foot storefronts, up and down streets such as Albany, Carlisle, Greenwich and Liberty. Their shelves and floor spaces were packed with vacuum tubes, condensers, transistors and other high-tech bric-a-brac for ham radio enthusiasts and do-it-yourselfers” (2002). The New York Times called it "a paradise for electronic tinkerers" (Adams 1950). Another

was less so when I noticed its location in the gray market and knock-off stretch of Canal Street. The cluttered shop—a "surplus store" more akin to a disheveled thrift store than a RadioShack—resembled a junkyard with shelves, brimming with unappealing electronic parts just barely clinging to life. Most of the equipment was in dubious working condition—what one might call a "fixer-upper"—or intended to be scavenged for components. In other words, it was a hacker's dream. The gruff salesman steered me towards a pair of unremarkable speakers, badly scuffed but purportedly functioning. Pleased with my ability to talk him down a few dollars for the pair (he would not let me purchase just one), I took some time to wander the street before heading to the workshop, passing signs hawking everything from car stereos and DJ equipment, on the electronics side, to perfume, leather, and jewelry. I had always viewed Canal Street as a one-stop-shop for tourists seeking fake designer handbags—not relevant to my or my interlocutors' everyday lives. But Argo Electronics' place in that ramshackle street scene seemed deceptively logical, a part of the local market ecology camouflaged by the chaotic performance of bargain-bin commerce.

From Canal Street, I could walk to Harvestworks, an apartment-sized venue ensconced even further into the commercial din, this time of the more upscale shops of SoHo. Over the course of several hours, Stearns led participants through the process of converting our scavenged speakers into amplifiers. Everyone present, in this case, was roughly an intermediate-level DIY music technologist; after all, we would be playing

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site emerged on West 45th Street in the wake of World Trade Center construction in 1966 and the eviction of former tenants, and further stores dispersed elsewhere. Perhaps the last surviving store from the original Radio Row is Leeds Radio, now a one-man-enterprise operating in Williamsburg, Brooklyn and still specializing in pre-1965 analog electronic components.

circuit-bent instruments of our own making the following day. Nonetheless, the workshop required meticulously deciphering electronics data sheets and soldering components in place. In contrast to the haphazard approach of the Transmediale e-waste workshop, Stearns maintained his usual pedagogical stance and slowly walked participants through the tedious “hows” and “whys” of building.

The crux of the speaker-to-amp transformation lay in the integrated circuit (IC) amplifier chip. Stearns stressed the importance of consulting data sheets for ICs—a skill for determining the form and function of parts when repurposing. In this case, we worked backwards: he had already chosen an appropriate IC chip for the new project. All chips are marked with identifying numbers (this one was TDA7056B), so we did an online search by its number for the corresponding data sheet, a 15-page document outlining such information as the chip’s features and intended uses, an electrical schematic diagram, a diagram of its pin configuration, and other technical specifications.[160] Its official name turned out to be a “5W mono BTL audio amplifier with DC volume control” (W=watts; BTL=Bridge-tied load), and we learned that it was suitable for battery-powered audio equipment. Thus, participants were introduced to the data sheet as the electronics tinkerer’s (and recycler’s) sidekick and the chip as a tool used to animate (or reanimate, as it were) formerly lifeless electronic devices.

Later, on a sweltering summer evening, Stearns and a handful of circuit benders met in DUMBO (Down Under the Manhattan Bridge Overpass), Brooklyn—directly, in fact, under the Manhattan Bridge. The Make Music New York festival is held annually

[160] Data sheets are often under copyright but are easily searchable online. An example from NXP Semiconductors can be found at: http://www.nxp.com/documents/data_sheet/TDA7056B.pdf.

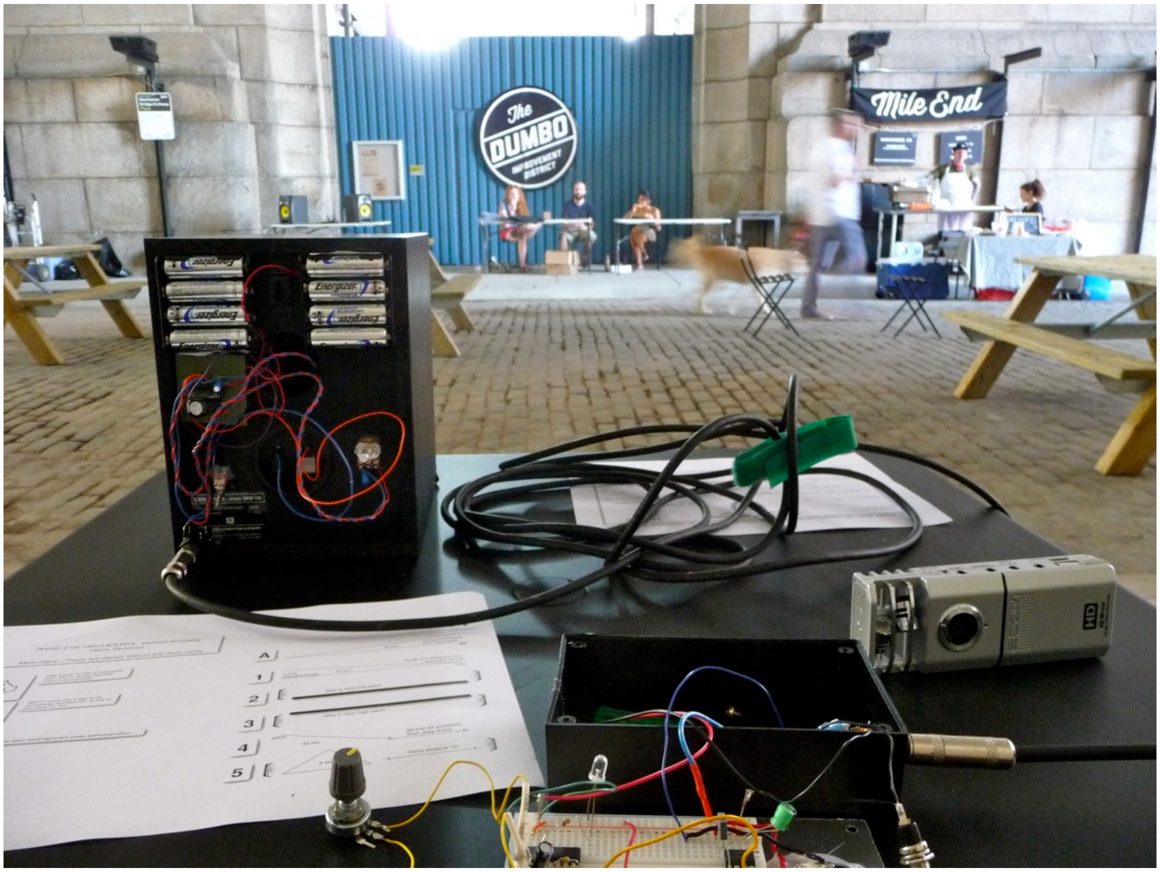

Figure 27. The author's setup at the Make Music New York: Circuit Bending Mass Appeal performance. Top left: Speaker-to-amplifier conversion; bottom left: Hans Tammen's score.

on June 21, the longest day of the year, and organizes over a thousand free performances. Sessions designated as "Mass Appeal" signify that anyone from the public may bring an instrument and join in. For circuit benders willing to brave the heat, Hans Tammen from Harvestworks conducted a version of his Third Eye Orchestra project for variable casts of experimental electronic instruments (also including homemade synthesizers and other oddities) performing one open-form score.[161] The challenge for circuit benders

[161] Loosely in the style of Earle Brown's earlier open-form compositions, Tammen writes graphic scores that nudge instruments with targeted instructions while allowing room for interpretation and the vagaries of each instrument's unique characteristics. Sections lettered A, B, C, etc. are juxtaposed numbered ones, each directing a performer to,

performing on often unruly and rudimentary creations is to harness sounds appropriate for an ensemble setting. Using our new battery-powered amplifiers, we tested our courage for amplifying our prototypical instruments to be heard by a crowd. The built-in element of chance in these instruments, unsurprisingly, resulted in some unmanageable cacophony. However, the passersby not driven away by the noise approached us with curiosity: *Just what on earth were we doing? Was this music? What possessed us to play such strange instruments?* Thus, the goal of stimulating the public imagination about the varied forms and sounds instruments can take was achieved, and we wailed away into the evening on our repurposed materials played through repurposed sound production equipment.

The Mesh and the Glitch

Overall, Stearns's involvement in circuit bending and repurposing materials fits into a larger pattern of work exploring connections between the environmental and the electronic. In 2012, for instance, he embarked on the Algorithmic Seashells project, in which his team created and 3D-printed[162] models of seashells, from both real and imagined designs, exploring the concept of scarcity. As documented by his collaborator Gene Kogan, they made mathematical models of the shells based on calculations by topologist Jorge Picado (2009) and formed the visual designs of mollusk shells in Processing (a popular coding platform used for Arduino and other Maker projects),

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perhaps, begin a volume swell, raise the pitch, or take a solo. Tammen displays flash cards with the corresponding section and uses a baton to conduct.

[162] I follow the orthographic convention of "3D" used by *Make* rather than "3-D," as used by other publications.

adjusting values such as “spirality, orientation, and surface features.”[163] These visual models are called a “mesh,” and they describe a general 3D modeling principle that comes from “the primary visual form in 3D computer graphics. Technically, a mesh is a collection of lines, vertices and faces that define the shape of a geometric object. Designers use meshes to draw 3D objects which rotate and reflect light. The mesh is basically a computerized version of modeling clay that a sculptor uses to create a form” (Stallings n.d.).[164] The design is then printed and bound with gypsum powder.

This specific use of “mesh” brings to mind Timothy Morton’s conceptualization of the term in *The Ecological Thought* (2010) as “‘the interconnectedness of all living and non-living things.’” Morton elaborates:

> “Mesh” can mean the holes in a network and threading between them. It suggests both hardness and delicacy. It has uses in biology, mathematics, and engineering and in weaving and computing—think stocking and graphic design, metals and fabrics. It has antecedents in both *mask* and *mass*, suggesting both density and deception. By extension, “mesh” can mean “a complex situation or series of events in which a person is entangled; a concatenation of constraining or restricting forces or circumstances; a snare.” (2010, 28)

Elsewhere, Morton argues that we must approach ecology without the baggage of “nature” (2007), a term that sets us astray in attempting to construct a problematic nature versus non-nature binary and that is not useful as a basis for addressing the types of projects examined in this dissertation. He adopts a notion of “dark ecology” that

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163 “Seashell Generator” instructions were posted on GitHub in 2012, a popular website for publicly sharing open-source code and related project ideas: https://github.com/genekogan/SeashellGenerator. Kogan describes the process further on his own website: “Listening to the Ocean,” http://genekogan.com/works/listening-to-the-ocean.html.

164 This undated description by William Stallings, “3D Modeling: What is a Mesh?” was found at http://networking.answers.com/definitions/3d-modeling-what-is-a-mesh.

"preserves the dark, depressive quality of life in the shadow of ecological catastrophe" (2010, 187). I believe his work speaks to what DIY music technologists are doing with repurposing: there is only sometimes talk of nature in itself. Rather, envisioning mountains of e-waste, my interlocutors recycle materials; envisioning the ever-looming cyborgian blurring of human-technology, they investigate boundaries; envisioning becoming the kind of person who makes a difference, they see themselves in a mesh. As Morton notes, we can often best express these novel, confusing, "unspeakable" realms of environmentalism through art (12); my interlocutors engage the ecological thought in their artistic explorations. The people behind Algorithmic Seashells imagine future generations who have never heard the sound of the ocean in a "real" seashell, only through digital facsimiles. They embrace obsolescence, failure, scarcity, and glitch; they appropriate these unsustainabilities as an aesthetic and put them forth as a dialog with a perceived audience.

In the glitch, failure itself becomes an aesthetic (Cascone 2000).[165] Glitch is at once broader and narrower than circuit bending or DIY music technology, as it encompasses a wide array of artistic media yet also refers to a specific technique and set of practices. According to Caleb Kelly, a glitch is "the digital tick caused by lost or incorrect binary code" (2009, 6). A kind of "cracked media," following in the vein of multimedia artists such as Naim June Paik and Christian Marclay, glitch as an art form came about in the 1990s with the rise in digital equipment affordable enough that one could experiment. In music, it emerged as a genre of electronica, perhaps best-known to a

[165] Scholarly treatments of glitch have exploded in the past few years, mostly within studies of new media (e.g., Kelly 2009; Krapp 2011; Nunes 2011; Steingo 2015). See also Rosa Menkman's "Glitch Manifesto" on her website: http://rosa-menkman.blogspot.com/2010/02/glitch-studies-manifesto.html.

popular audience through the work of the German group Oval, who purposefully damaged CDs and sampled the errors to use in new compositions; meanwhile, some its most prominent visual artists include Cory Arcangel and Rosa Menkman, whose work has thrived in 2000s despite the genre's critique as exhausted and overplayed by this era, leading many of its purveyors to abandon the practice (7).[166]

Stearns's other work falls extensively into the realm of glitch art, expanding his circuit bending into wider terrain. For instance, in a performance I have seen many times, Stearns "bends" the electronics within a digital camera, resulting in unintentional visual output that he projects onto screens. He took this practice a step further in 2012 with Year of the Glitch, for which he posted a different glitched ("short-circuited") camera design online every day for a year, and Glitch Textiles, for which he pursued many of these designs to their tactile ends by fabricating blankets, scarves, and tapestries. His textiles represent the "woven" interconnectedness of "our presence in environments saturated with networked digital technologies," he writes on his website. "By making data in its many forms both visible and tangible, [the textiles] generate an awareness of and dialog about the ways in which our critical engagement with science and technology is crucial for determining how we live today and will live in the future."[167]

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[166] Stearns has spoken effusively about glitch many times during our conversations and has directed me to works by Rosa Menkman and others taking glitch in new directions.

[167] This is not Stearns's personal website but rather his product merchandising one: "About Glitch Textiles." http://glitchtextiles.myshopify.com/ pages/about.

Variations on a Theme of Recycling: Further Vignettes from the Field

Mending and Making: Waste at the Maker Faire

Maker Faire 2014 turned the issue of recycling on its head. On the one hand, I spotted repair booths specializing in teaching Makers to revamp their inventions. In a giant tent called the "Maker Shack," official *Make* magazine merchandise even re-used RadioShack products for commercial purposes, wrapping new packaging over the old. Making is trendy, and RadioShack—which had been struggling for many years (Harris 2014)—was trying fervently to capitalize on its success.

On the other hand, at its worst, the Maker movement also produces and encourages excess waste. To quote an oft-heard platitude by those critical of the movement, "Just because you *can* doesn't mean you *should*." For all their attempts to reuse materials from one project to the next, Makers are generally hobbyist builders, continually learning fledgling skills and therefore continually making mistakes. They purposely put themselves in the position of learning to build projects on which they are not experts. In addition to hours or more of time put into a project that may or may not succeed, wasted or damaged materials also must be scrapped. Done once, this waste likely has a miniscule effect; done repeatedly, the waste multiplies in excess.

At Maker Faire 2014, I happened by a booth for the Fixers' Collective, which billed itself as "a social experiment in improvisational fixing, skill sharing, and aggressive asset recovery" on the posted placard. The collective is based at Proteus Gowanus, as a project-in-residence at this gallery, reading room, and event space in the

Figure 28. RadioShack soldering kit re-packaged for Makers

eponymous Brooklyn neighborhood.[168] Each year since its 2005 inception, Proteus Gowanus has commissioned a community-oriented artistic theme for ongoing projects; the Fixers' Collective was born of the 2008-09 "Mend" theme—and never stopped. Once a month (in addition to one-off sessions at other locations, such as Flux Factory, Hack Manhattan, churches, libraries, and farmers' markets), community members can bring

[168] Gowanus, home to one of the United States' most polluted bodies of water, the Gowanus Canal, is another hub for DIY activity due to its relatively lower rents and ample warehouse space. This reputation as a wasteland for hazardous materials, although perhaps a coincidence, makes it an especially apt setting for DIY recycling practices. The 2014 addition of a Whole Foods supermarket is said to be a harbinger of increased gentrification and rising cost of living, however.

Figure 29. Booths at Maker Faire 2014:
Fixers' Collective (with Pop-Up Repair in background)

broken items to the "fixing table" where an "assembled group will share ideas and techniques for repairing, mending, enhancing or repurposing the objects before us."[169] Their mission statement reflects the values seen elsewhere throughout this chapter:

> Our goal is to increase material literacy in our community by fostering an ethic of creative caring toward the objects in our lives.
>
> The Fixers' Collective seeks to displace cultural patterns that alienate us from our things, by collectively learning the skills and patience necessary to care for them. Intentionally aligning itself with forces generated in reaction to the current economic crisis, the Fixers' Collective promotes a counter-ethos that values functionality, simplicity, and ingenuity and that respects age, persistence and adequacy.
>
> The Collective also encourages participants to take liberties with designated forms and purposes, resulting in mended objects that may exist both as art and within a more limited, utilitarian context.[170]

[169] "Projects-in-Residence: Fixers Collective": http://proteusgowanus.org/fixerscollective.

Meanwhile, their social media links to articles on electronics recycling and lists of items they have fixed; particularly musical items include synthesizers, stereo receivers, record players, headphone jacks, and other instruments.

At the fair, the Fixers' Collective was stationed next to Pop-up Repair, another experimental project repairing household items brought in by community members. The latter project is the brainchild of theater professionals—a performative "intervention in the cycle of use-and-discard consumerism" (Pop-up Repair). Barnard College theater professor Sandra Goldmark and theater production manager Michael Banta launched the idea after feeling that environmentalists too often neglect opportunities for "repair" in larger discourses on recycling: "It is a part of waste reduction and sustainability that is underdeveloped," Goldmark explained on the university's website. "We are facing enormous problems on this planet that can't wait—we can't just recycle our way out of this mess. We have to extend the life of objects as well."[171] To address this deficit, they gathered others working behind the scenes in theater, who channeled their constructive artistry typically used for set-building and improvisational prop repair. As volunteers are not necessarily experts in the items serviced, owners pay a small fee and are sometimes asked to return a few days later, after Pop-Up Repair has had time to research the items and determine a course of action.[172] Pop-up Repair maintained its own storefront in the Upper Manhattan neighborhood of Inwood for a month-long trial that is now repeated on

[170] From the Fixers Collective website: http://www.fixerscollective.org/about.

[171] The write-up on the Barnard University website is available at: https://www.barnard.edu/news/prof-sandra-goldmark-and-michael-bantas-pop-repair-shop-merges-sustainability-and-social.

[172] Instructions can be found at http://www.popuprepair.com/?page_id=308.

a semi-regular basis around New York; like the Fixers' Collective, they, too, cycle through markets and fairs, and even temporarily set up shop in Gowanus, this time inside the non-profit Film Biz Recycling.[173] They received substantial press coverage for these endeavors and seem to have captured a cultural zeitgeist that reflects the success of the Maker movement but also reaches beyond it, into community spaces where people value practicality over hype.[174]

Despite this emphasis on sustainability, there is tension in the Maker community about the role of 3D printing for rapid prototyping and the creation of waste. Returning to this technology used in the seashells example, 3D printing is one of the top three tools promoted by the movement, along with the Arduino and Raspberry Pi. (While the latter two are specific products, 3D printing is a referring to as a general technology.) It involves first creating a design with modeling software—from the practical to the fantastical—and loading a cartridge of powered or liquefied material, or filament, into the designated printer, which then slowly, successively deposits imperceptibly thin layers of the material into the desired shape, until a three-dimensional solid model is complete.[175]

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[173] Although beyond the scope of this chapter, Film Biz Recycling provides another entrance into the arts and media recycling trend, explaining in its mission statement that it "prevents pollution, creates jobs and aids our community by diverting entertainment industry wardrobe, furniture, props and set materials to local charities as well as operating a retail prop shop open to the public and the trade in Gowanus, Brooklyn. Since its inception in 2008, FBR has diverted over 500 tons of materials from the NYC waste stream! #notinadumpster." One may rent or buy props and costumes for films shot various historical periods, including outdated electronics such as giant cell phones and early models of computers, and participate in "eco workshops" and a "DIY/upcycle studio." More information is available at http://www.filmbizrecycling.org.

[174] See, for example, Margolies 2014; Royte 2013.

[175] In New York alone, numerous 3D printing start-up companies have emerged, such as MakerBot, which manufactures printers and sells digital model designs, and Shapeways,

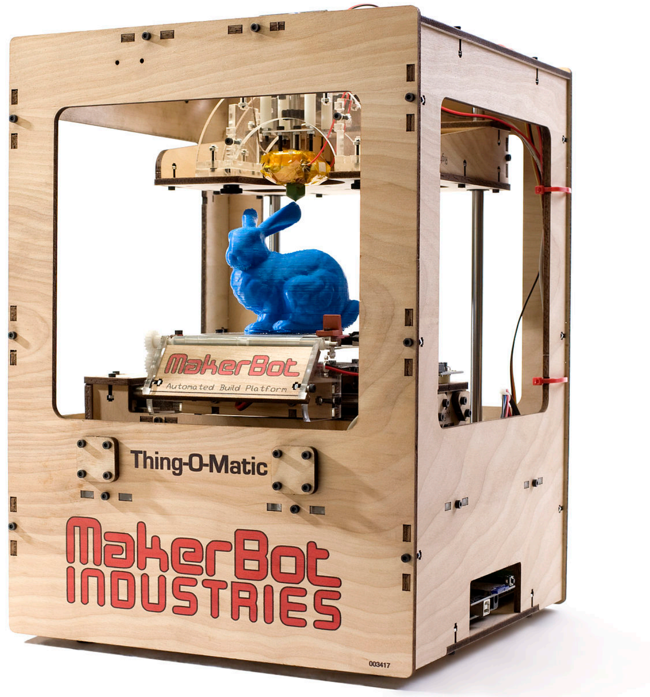

Figure 31. MakerBot Thing-O-Matic:
3D Printer model debuted at the 2010 New York Maker Faire
(Image available through Creative Commons via Wikipedia)

the material into the desired shape, until a three-dimensional solid model is complete.[176]

The hope is that 3D printing can help salvage old materials, encouraging users to design and print hard-to-replace parts instead of purchasing an entirely new item. The Shapeways online marketplace offers an array of custom replacement hooks, mounts, adaptors, instrument mouthpieces, and even battery doors for those broken off of

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which prints designs for users and then allows them to sell these in an online marketplace.

[176] In New York alone, numerous 3D printing start-up companies have emerged, such as MakerBot, which manufactures printers and sells digital model designs, and Shapeways, which prints designs for users and then allows them to sell these in an online marketplace.

appliances. In reality, however, 3D printing also provides unparalleled opportunities to make—and make and make—new and often unnecessary items through a process called rapid prototyping. For instance, in the same livestream during which performance group GLANK demonstrated their found-percussion instruments (below), a Maker Faire attendee boasted of her quick production output in creating a plastic phone holder that doubles as an amplifier: "This one went through 37 versions to come to life, over six weeks, so that's more than one per day." Now available for sale on Shapeways, production would have multiplied, sending innumerably more phone holder-amplifiers out into the world at the cost of $55 each. Hod Lipson and Melba Kurman call this "exuberant waste," explaining that well-intentioned Makers might not realize "the downstream costs of their actions" (2013).

3D printing's potential for musicians and music researchers is enormous: reconstructing ancient instruments, prototyping new ones, modeling custom or hard-to-find parts for rare instruments, and so on. Beyond the hype (as *The Economist* once requested, "Print me a Stradivarius!"),[177] some operating questions are: Is the construction durable? Are the acoustics of high quality? Can a 3D printer ever match the craftsmanship of a luthier?

3D printing also opens up an alternative to the destruction of natural materials for building instruments. Embedded in larger discussions of ecology (such as "ecomusicology")[178] and sustainability (such as those framed by Jeff Todd Titon)[179] are

[177] No author is listed; the article from February 10, 2011 is archived online at http://www.economist.com/node/18114327.

[178] "Ecomusicology" as an approach to "ecocritical musicology" has been prominently addressed by a "colloquy" of writers in the *Journal of the American Musicological*

concerns about scarcity and long-term investment in the cultivation of materials for musical instrument building.[180] While scholars who emphasize the sustainability of instrument-building materials privilege "natural" materials for superior artisanship and sound quality, they may also (often reluctantly) recognize the long-term importance of "harvesting" non-natural materials. Meanwhile, DIY music technologists are interested in "good stewardship" (Titon 2009a), working through conflicts of waste and scarcity in order to practice the cultivation of selves and materials.[181] I believe that scholars,

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Society (2011), but as they acknowledge, encapsulates a broad range of views beyond those easily classifiable as musicology. See also Guy 2009; Pedelty 2012; Ramnarine 2009; Rice 2014; Schafer 1977; among others.

[179] Titon emphasizes sustainability as germane to cultural policy and as both an ecological and an economic issue. Based on the idea of "good stewardship," he views music itself as a "sustainable biocultural resource" (2009a, 7). He steers readers away from adopting a heritage preservation perspective, which he finds privileges a defensive stance towards the past at the expense of novel creations; instead, he argues that conservation ecology holds more productive lessons for musical sustainability (2009b, 119). He identifies four principles: "diversity, limits to growth, interconnectedness, and stewardship" (ibid.) that are also found throughout this chapter: wildly diverse instruments, tensions about growth (waste), the interconnectedness of the "mesh," and cultivation as stewardship.

[180] The scarcity of rare woods due to over-forestation poses an especially complex legal situation: the Lacey Act, a 1900 U.S. law banning the trade of illegally-procured wildlife, was amended in 2008 to also curtail illegal logging by requiring all companies—including prominent guitar manufacturers such as Gibson and Martin—to use their own means to ensure that any wood in their possession is cultivated sustainably. The law thus joined CITES, the international Convention on International Trade in Endangered Species of Wild Flora and Fauna, in this quest. The intricacies of implementing and enforcing this act whipped up a legal and journalistic frenzy, resulting in numerous recent publications, as well as the documentary film *Musicwood*. See Genova 2013 and Pryce 2012 for an overview, among other scholars on this theme (e.g., Allen 2011; French, Handy, and Jackson 2009; Welch 2001).

[181] For example, Koji Matsunobu (2013) has stressed the importance of harvesting bamboo as part of the shakuhachi-building process, in which increasing numbers of students and performers embrace a "slow-food approach" of "nurturing" their instruments

musicians, and Makers can agree on the urgency of (re)using materials that meet high acoustic standards without depleting natural resources: which is to say, musician-inventors are right to see merit in 3D printers despite the new technology's inherent contradictions (generating waste in the quest to prevent it).

"Rescuing" Electric Guitars

Through 3rd Ward, I also met Ben Simon, who was advertised as teaching a summer "Electric Guitar Rescue" course that would teach participants to reimagine and refinish new versions of the guitars from old or broken ones. When I wrote to him about registering, he reluctantly said that the course was about to be canceled (likely due to lack of enrolment, though he had taught it successfully in the past), so we arranged instead to meet at his apartment-workshop in Bushwick to discuss his own rescued guitars. In that sparse setting of unfinished furniture, cinder blocks, and linoleum, Simon traced his fascinating and winding journey from at-risk youth to woodshop employee to teacher, luthier, and musician-inventor. "I always took apart my guitars growing up and always wanted to make my own guitar," he explained. "…It took me about 6 months to realize that guitars are made of *wood*, and I'm now working in a *woodshop*, and this might be a possibility. […] And all the sudden, you're in the woodshop getting paid to make a drawer, but you've learned how to build all this other stuff, as well. So in my case, that would be musical instruments" (interview, Sept. 4, 2012; statements reordered for clarity). Money was dangerously tight, he confessed, and he had to be resourceful, but the drive to invent was stronger than the desire to lead a comfortably conventional life.

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in search of a "self-transformation"—a "co-evolution with the flute" (196)—through understanding the craft and material sources of their instruments.

Figure 31. Ben Simon at home in Brooklyn with one of his custom guitar projects, Sept. 2012

At one point, Simon demonstrated a hacked guitar that was a particular point of pride for him:

> Simon: I just completed this guitar over here. *It was built for my own performance and the way that I play music, and also for playing on the street.* It's fully battery-powered. [….] It's been a long time coming, and it was this huge undertaking to build it, and gathering all of the parts, and getting all the money together. It's the longest project I've ever—it's about 500 hours, I would say, on this one project. […] And I've taken it out onto the subway, played it a few times in the subway, played it in the club a few times, brought it to the recording studio…and it's done great. So I'm really looking forward to whatever is coming up next with it—*hopefully not the sewer*.
>
> [*After some other discussions, he returns to the guitar again.*]
>
> Simon: So you are seeing one person here with his vision totally fulfilled. This is it for me. There is nothing in the world that I need to do other than this.

> Author: Were you inspired by anything in particular to make that? Like seeing a certain design that someone else had made or anything…
>
> Simon: No way, man!
>
> So this is an octave of keys […], and there's an amp here. And this is a 4-channel mixer. Can turn the guitar up and down, microphone up and down. Can change the drone sounds. This is a Yamaha keyboard from, like, 1990. I don't have knobs for these yet, so you get that hum when I touch it. But if there's a plastic knob there, it should be okay. And then, drums. Oh, that's out of tune. [*Tunes guitar.*] The keyboard can do different effects like vibrato and chorusing. I can switch the drone notes with the chord.
>
> So that's it. I'll show you the back. It's got a reverb unit here that I leave on most of the time, and then this is a keyboard circuit, below that's a drum machine, this right here is a mixer, mic preamp there, this is another part of the keyboard, and that's the amp right there—a 20 Watt amp. And you can see that *these are all hacked circuits*, they all came from other devices. I would have no idea how to build these from scratch. (Interview with author, Sept. 4, 2012; emphasis mine)

In this example, we can see how adaptable the idea of repurposing is. Circuit benders have a particular view of what it is that they are doing with repurposed electronics, sound artists building installations have another, and Makers using 3D printers yet another. His language above shows how Simon represents an especially musician-oriented approach: his instruments must suit his musical sensibilities, a desire to stick within the parameters of a traditional guitar design, a need for functional playability for performance, a lack of in-depth electronics knowledge (compared to Stearns, for instance, but more than many others), and a need for a visually appealing object that will attract attention as he busks on the subway.

Found Sound(boxes)

Another example is American-raised, Berlin-based instrument builder and sound artist Derek Holzer's Soundboxes (profiled further in my introduction). In May 2013, I took his workshop at NK Projekt, designed to "[d]iscover the hidden sonic qualities of objects from our everyday world…." (He has sometimes subtitled this workshop "Neanderthal Electronics" due to the goal of making instruments using simple, mundane objects.) The Soundboxes have individually-decorated exteriors based around the same components: a speaker, an amplifier, a contact microphone,[182] and Holzer's custom circuit. Participants were instructed to bring their own enclosures inside which to assemble the electronics—in short, a box—as well as an array of found objects (e.g., bells, shells, springs) to use as sound sources to be picked up by the contact microphone. The repurposed box itself, while open-ended, must meet some specific criteria:

> This should be made of thin wood or very strong cardboard. Plastic can be also used, but it doesn't sound very good. And please, no metal! It is too difficult to cut and drill with the tools we will have. This box should be a minimum of 10x10x4cm, or bigger if you want to use a larger speaker or have more room to decorate and add objects. Cigar boxes, small suitcases, instrument cases or jewelry/silverware boxes are all good things to look for. At least one side of the box should be no more than 5mm thick, to allow the hardware to be mounted.[183]

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[182] Contact, or *piezoelectric*, microphones play a significant role in DIY music technology projects. *Piezo-* means "to press" or "to squeeze," and these sensors are triggered by touch or pressure, converting the vibrations into electrical signal. The main difference between these and other microphones is that they transduce vibrations from solid objects, rather than air. Thus, they are ideal for the found objects used in conjunction with Soundboxes. Even the contact microphones themselves can be DIY projects; I took a prior workshop called "Piezophonia" to do so at Brooklyn's 3rd Ward, in which we prepared them to record underwater sound sources.

[183] From the Soundbox event page: http://www.nkprojekt.de/soundboxes-workshop-with-derek-holzer-2

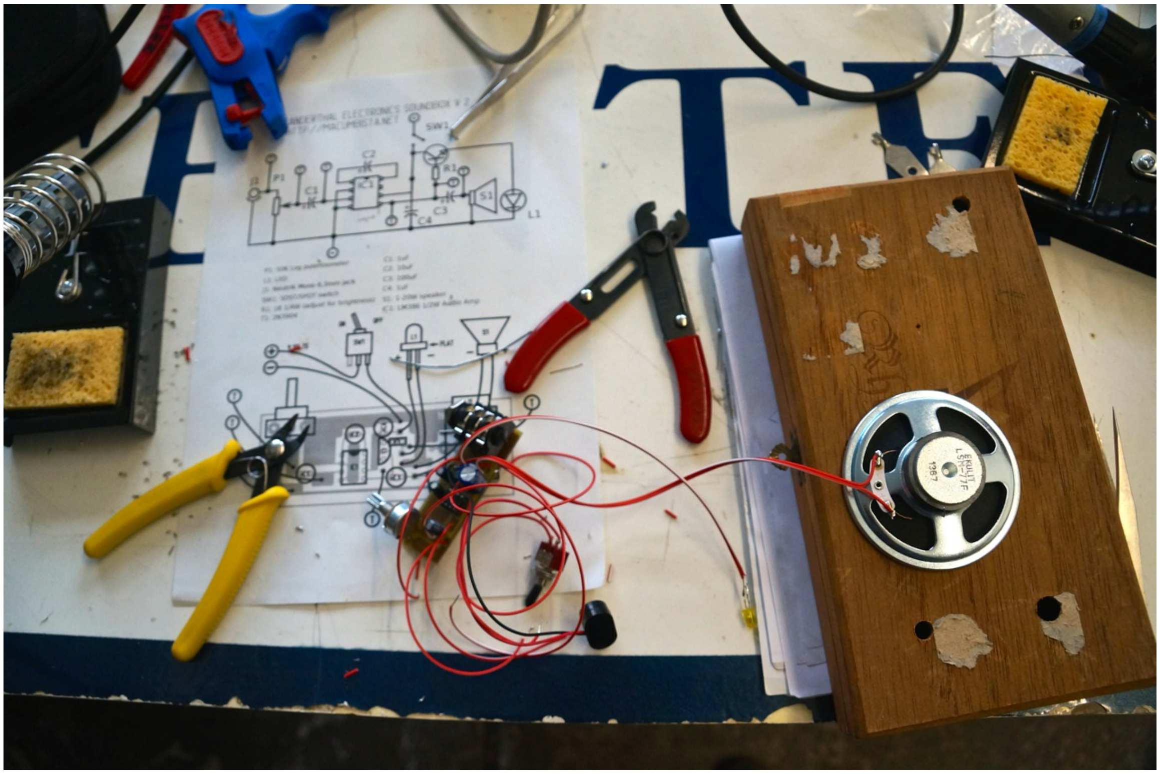

Figure 32. The author's Soundbox in progress, NK Projekt, May 2013
Also visible are reusable tools: soldering irons, wire strippers, wire cutters, tweezers, and calipers (for measuring box thickness)

The vintage briefcase I acquired from a thrift store turned out to be more than 5mm thick, but Holzer came prepared with several extra cigar boxes, salvaged from who-knows-where in far-from-pristine shape. Here, as in most DIY music technology workshops, we also reused as many building tools as possible. The instructor and venue typically determine which of them can provide equipment (likely soldering irons, desoldering wicks or pumps, alligator clips, clamp stands, wire strippers and cutters, and pliers), as well as leftover soldering wire and electronic components from prior workshops. Soldering irons are by far the most important of these tools, as they are used in most workshops, and high-quality ones can cost over $100. Students are sometimes asked to provide additional materials (as we did here), to bring along their own tools to share, or to pay a materials fee (often inseparable from the cost of the workshop). At the end, materials are carefully re-collected and stored for the next usage. The goal is to create as little waste as possible and to conserve resources, both physically and financially.

Also along these lines, the found-object percussion group GLANK performs at Maker Faire each year, transforming propane tanks and other industrial objects into instruments and using them to demonstrate rhythmic concepts for the audience (see the binary ostinato patterns in Figure 33). In a 2014 video interview with *Make Magazine* correspondents, one of the intentionally anonymous percussionists explains:

> This is a propane tank, just like a regular LP tank that you'd find in a barbeque set, it's turned upside down. What I do is I actually cut different pitches into the metal itself. So don't try this at home. If you use a used one, the LP gas actually embeds into the metal itself. So I use a detergent, I wash it out for a couple days. I'm prone to buying new ones now because they're inert, they're empty…much safer. So this is an old one I found. But I basically start cutting pitches, and I basically try and find the way it resonates kind of naturally in the tank. I'm not sitting there with a tuner, I'm not looking at a C scale or anything like that. I just try and find what sounds good. So literally, like, cutting that much [indicates a length] is making that tongue longer and bigger, and the pitch goes down. So I just find what sounds cool. It's a little odd, it's a little dissonant, but that's kind of where I live. And they sound great with hands, and different activators [types of sticks].
>
> This is obviously march-able. It's a mobile tank. And we do different old drum corps styles…we do back-sticking and things that take me back to my old marching band days. This is just one of many, so, assorted stuff. This is a heat sink from an old Mac G4. [….] Stuff that people probably don't know about…this is an aluminum ice cube tray. It's so beautifully engineered. And I do nothing to this…I just found it and thought it sounded cool.
>
> So this is a 90-millimeter artillery shell, which, in its former life, made a *horrendous* noise. And what I do is, same principle [as with the propane tank], I'm just cutting different pitches into it. [Demonstrates sounds.] And it just rings forever. It's amazing. So I've got about twelve of these,

> different sizes, and I've got some that I actually cut off to make them different pitches—the actual artillery shell itself.[184]

In this sense, DIY music technologists' repurposing of materials fits into a broader history of found-object art (including a subgenre of "trash art") and found sound, the former of which incorporates everyday objects into artistic projects or instrument building, while the latter incorporates recordings of such objects into compositions. Some notable forerunners employing these techniques in experimental music and sound art include the aforementioned glitch music, *musique concrète*, the Japanese Groupo Ongaku, John Cage, Harry Partch, and Brian Eno, among many others.[185] But using found objects is not confined to a Western experimental approach; beyond experimental music, countless more examples abound that are guided by very different cultural and musical aesthetics: turntablism, in which turntables were repurposed from sound reproduction equipment to instrument via hip-hop (Holmes 2012; Katz 2012); the Zimbabwean Shona *mbira*, attaching shells and, later, bottle caps to the instruments' soundboards to produce a desired buzzing effect (Berliner 1978); the Yemeni *sahn nuhasi*, a copper tray reenvisioned as a percussion instrument (Bakewell 1995).

GLANK, when removed from its family-friendly context at the fair, also evokes the legacy of industrial music. This genre looms especially large in Berlin—not least of all due to the influence of local industrial band par excellence, Einstürzende Neubauten, and the an intangible abandoned factory aesthetic that pervades to this day—and many

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[184] This video was livestreamed on *Make*'s Youtube channel (https://www.youtube.com/user/makemagazine) on the date of the event and, to my knowledge, is no longer available online.

[185] See especially Labelle 2006 on the use of found sound in experimental sound art and Westerkamp 2002 on linking ecology with composition using found sound.

Figure 33. GLANK's Found-Object Percussion, Maker Faire 2014

DIY music technologists there (including Derek Holzer) and abroad reference its effect on their musical projects. As chronicled by Alexander S. Reed, early (pre-1990s) bands in the genre were characterized by "technological misuse, found sound, improvisation, location-specific events, and urban provocation" and often "the sound of banged scrap metal [achieved by] finding, pounding, and recording an oil drum" (2013, 286). If we consider this "intentional misuse of machines in search of the revelatory malfunction" (ibid.) as central to DIY music technology—but separate from industrial music's specific branding of this activity as merely destructive and nihilistic[186]—and linked to found

[186] Reed nuances this common take on the genre, framing industrial music not simply as nihilistic but also as dealing with "waste" in its own way, by seeking "music's possible function as the processing and purging of waste in clearing the toxic way to some unthinkably distant freedom" (2013, 7).

Figure 34. Circuit bending as "found object" instruments at Maker Faire 2014, Burnkit2600's Circuit-Bent Open Jam

sound, reuse, and glitch, we arrive at an aesthetic of not just failure (as Cascone theorized earlier), but of reprocessed and recycled failure. The point is to repurpose breakdown, to reimagine rupture, to salvage obsolescence. Makers have developed from the larger DIY music technology community an ethic of innovatory cyclicality—a deeply held attention to the life cycles of instrument-building materials and a drive to rescue the neglected and resuscitate the dead.

Drawing from a cultural context vastly different from the United States and contemporary Berlin (but, notably, not Cold War-era Berlin; recall Böhme-Mehner 2011a in the introduction)—that of Communist Cuba—designer Ernesto Oroza has called this phenomenon "technological disobedience." In conversation with Oroza, journalist Jenny Marder writes:

> [Cubans] learned to disrespect the "authority" of objects. That meant rethinking their original purpose and life cycle.
>
> People scoured the city for plastic objects and industrial discards and swiped garbage from city dumpsters, which they'd grind up and inject into molds to make toys, dishes, electrical switches and footwear. The magazine *Popular Mechanics* was a hot commodity on the island.
>
> "Industrial products were tinkered with and examined by hand," Oroza said. "Cubans dissected the industrial culture, opening everything up, repairing and altering every type of object." (2015)

Meanwhile, as Gavin Steingo (2015) illustrates regarding Soweto, a collection of townships in South Africa, the social circumstances that dictate residents' immobility vastly affect their interactions with sound technology. Steingo profiles musicians who cannot readily leave their homes without fear that their belongings will be stolen; these musicians are also tied to social obligations for lending and borrowing in which items are often returned (if they are returned at all) in an altered state. For instance, computer hard drives that "circulate among an always-expanding network of people are liable to break or get viruses" (113). The technological breakdown resulting from sharing and recycling electronic materials "enables alternative aesthetic forms" such as glitches and layers of modifications of existing material (114).

This kind of DIY-by-necessity takes recycling to its logical extremes but also encapsulates the larger process at hand, celebrating the human capacity for (re)invention. Under scarcity, repair and reuse becomes the norm. To do so in a cultural context of overconsumption reflects an awareness of the absurdity of waste and planned obsolescence, of the interconnectedness of Morton's "mesh" and of care for the life cycles of things.

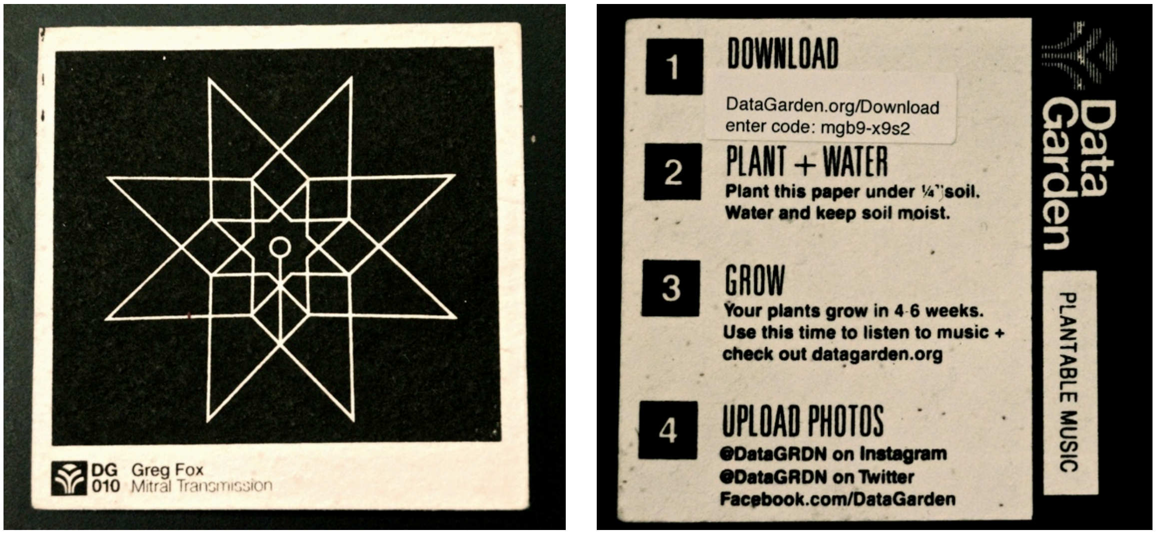

Figure 35. Data Garden record release:
Greg Fox, Mitral Transmission

Finally, yet another interpretation of repurposing and recycling is found in the record label Data Garden. Although Philadelphia-based, I attended their record release event for New York drummer Greg Fox's *Mitral Transmission* in March 2014. Held at the Institute for Contemporary Art as a sound art exhibition followed by a concert, the main draw was Fox's use of his own biorhythms to generate live music ("mitral" refers to a cardiac valve).[187] I waded through the surprisingly large crowd of mostly students and underground musicians to make a paint rubbing, or frottage, of a few environmental designs, to test how an interactive installation channeled my body as sound waves, and to

[187] Fox was also accompanied by a keyboardist and a peculiar device called the MIDI Sprout, which was said to "read" and "sonify" the biorhythms of plants. Data Garden director Joe Patitucci showed me the early prototype of this device, for which he later helped launch a Kickstarter campaign to successfully manufacture for the public. The use of biofeedback in music performance is becoming increasingly common, as evidenced by Phil Stearns and Marco Donnarumma, the electronic "jungle" at Ausland described in the prior chapter, and many other instances.

purchase an album of "plantable music." The latter is Data Garden's signature: both a sales gimmick and a creative reuse of materials, "albums" are re-envisioned as seed packets. The small souvenirs, no bigger than one's palm, are imprinted with album art on one side and instructions on the other side, which include a digital download code for audio mp3s, suggestions for planting and watering the packet, and the label's social media handles.

Since no physical medium is necessary to transfer the album, merely the download code could suffice. However, Data Garden recognizes listeners' desires to preserve the album-buying experience and obtain meaningful objects surrounding their purchases, while also cutting back on the inherent material waste involved. As they explain in their mission statement, "Digital files are easily lost by the impermanence of computing. Physical objects like CDs, tapes and records last far beyond their usability and possibly even our existence as a species. We seek to address these challenges by releasing digital album codes on artwork that can grow into living plants."[188] Thus, one may buy the merchandise, admire the design, download the tracks, and then transform the medium into plant life.

In this section, the case studies point to the surprising centrality of environmental issues like sustainability, waste, and conservation of materials in DIY music technology projects. Taken together, we can see a pattern of thoughtful engagement with these issues that is realized through the act of repurposing.

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[188] From "About Data Garden" at http://datagarden.org/about.

Conclusion

In addition to theorizing circuit bending as zombie media, Jussi Parikka went on to author *What is Media Archaeology?* (2013):[189]

> …[A] way to investigate the new media cultures through insights from past new media, often with an emphasis on the forgotten, the quirky, the non-obvious apparatuses, practices and inventions. …[I]t is also a way to analyse the regimes of memory and creative practices in media culture—both theoretical and artistic. Media archaeology sees media cultures as sedimented and layered, a fold of time and materiality where the past might be suddenly discovered anew, and the new technologies grow obsolete increasingly fast. (3)

Out of all uses for media archaeology, Parikka continues to pay special attention to "repurposing dead media with a DIY spirit and methods" (14-15), and rightfully so. We have seen in his chapter that there are myriad layers to be excavated within DIY music technology and DIY recycling, from the vestiges of residual technologies and cultural practices to the life cycles of instruments to the sheer variety of projects undertaken. We surveyed a sampling of these projects (circuit bending, glitch, guitars, seed pods), as well as the spectrum of personal motivations behind these projects (intended to engender unique performances, social experiments, environmental awareness, et cetera). We also saw some of the contradictions inherent in DIY recycling, especially as embodied in the Maker movement: the tendency for DIY music technologists to always *make something* is at odds with their use of recycling to demonstrate their investment in environmental sustainability. Thus, I have argued that these practices, rather than signaling environmental activism, demonstrate the capacity for productive citizenship in an array of domains (cultural, ecological, scientific) that musician-inventors possess and can activate

[189] See also Parikka's edited volume on the subject with Erkki Hutamo (2011), his media archaeology of computer viruses (2007), and his archaeology of animals and technology (2010).

through their work. They are not alone in this increased awareness of ecological importance: beyond Timothy Morton's work, Aaron Allen (2011) points to the "greening" of the humanities (including musicology), while scientists and designers have advocated for the "upcycling" of products (McDonough & Braungart 2013). But the playfulness with temporality, the willingness to scavenge for art's sake, and the timeliness and ubiquity of not just making but *Making* conjoin to locate DIY music technologists as media archaeologists on the cultural edge of recycling.

Chapter 4

Blueprint for the Underground: Guitar Effects Pedals, Technoaesthetics, and Community at Death by Audio

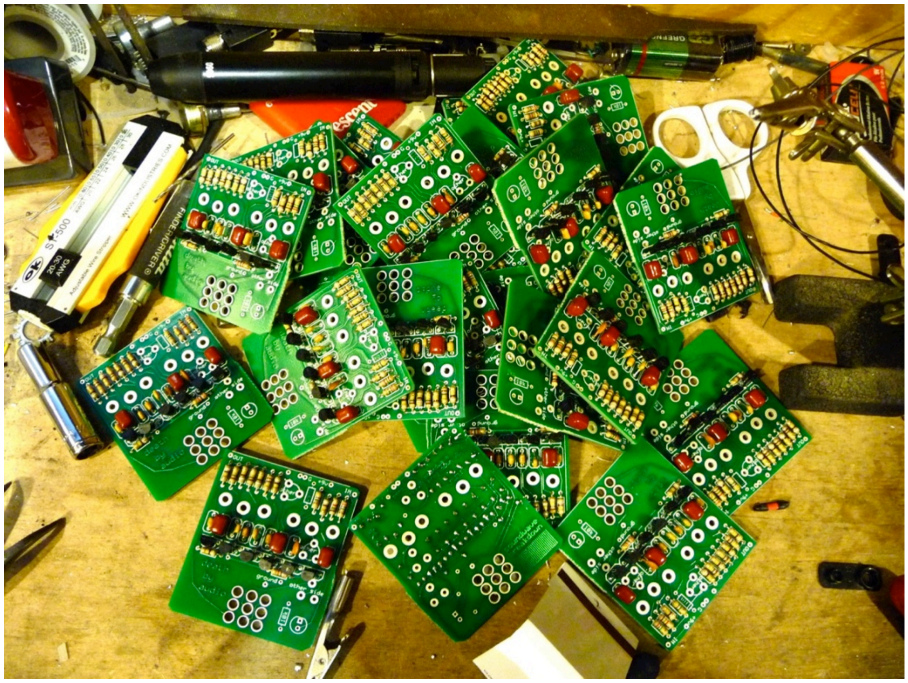

Figure 36. Circuit boards on the workbench awaiting guitar pedal enclosures, Death by Audio, February 2010

Introduction: *The DIY Guitar Pedal Workshop*

My first time entering the workshop at Death by Audio felt like descending into the cramped quarters of a mad scientist—one who finds inspiration in creative and material disarray. After passing down the dark hallway of a warehouse near the Brooklyn waterfront, flanked by a DIY performance space on one side and bedrooms for a few tenants on the other, I was led through a bi-level lofted living space, past a band rehearsal room, and into a room designated for the sole purpose of building guitar pedals. Drawers full of electrical components lined the walls, stacks of screen-printed boxes reached the ceiling, and tools hung haphazardly from nails in the unfinished wood that partitioned off the workshop. A notebook filled with sketches of design ideas was tossed onto a side table. A solderless breadboard, a sort of circuit board in which components and jump wires can be "plugged in," tested, and easily repositioned, displayed prototypes for these designs. Recently built pedals were strewn about, displaying such names as Total Sonic Annihilation, Fuzz War, Robot, and Soundwave Breakdown. Half-built pedals, their unclipped wires protruding almost dangerously, lined the workbench, where business owners Matt Conboy and Oliver Ackermann were busy handling the soldering irons. Throughout the afternoon, friends occasionally popped in to chat, plan rehearsal times, offer help with soldering, or air grievances about jobs (or lack thereof), demonstrating a communal space with porous boundaries between roles as residents, friends, and employees.

This was the spring of 2009, and I was there on my first visit to see how this DIY guitar effects pedal business operated. I had recently accompanied a friend to a performance at Death by Audio's "show space,"[190] where I found a Brazilian rock band setting up in a sparse, smoky room with a small stage, ceiling tiles dangling precariously, and an unmentionable toilet situation, as DIY venues are wont to have. The venue could be reached from the outside through a separate, unmarked entrance; unbeknownst to me at the time, another entrance led to the corridor connecting to the rest of Death by Audio.

[190] I will use the following terms to identify the various parts of Death by Audio: the "venue," or "show space," is the separate performance space; the "workshop" is the boutique guitar pedal factory; the "living space" is the bi-level area comprising a kitchen, seating, and thin-walled rooms for tenants, which are connected to the workshop. I will also use "venue" at times to refer to the Death by Audio as an entire entity. Less relevant for our purposes are the rehearsal space, the more recently reconfigured recording/monitoring room that turns the rehearsal space into part of a recording studio, and the separate rooms for tenants down the hallway. CTA Digital, a local multimedia technology accessories business, formerly occupied second floor beyond the living space.

After hearing rumors about a guitar pedal factory within, I then met an electrical engineering student and former audio engineer who previously assisted with building pedals there. The time seemed right for further investigation, and I figured a visit or two would suffice, unaware that I would find myself there for numerous performances, interviews, and social gatherings over the next five years, both in a formal research and an informal capacity.

Death by Audio began circa 2001 solely to manufacture a guitar pedal called the Total Sonic Annihilation. Founder Oliver Ackermann is a guitarist who studied industrial design at the Rhode Island School of Design. As a high school student before the explosion of internet forums (and long before today's Makerspaces), he logged hours learning about electronics but faced many setbacks. "I did check out a few forums, went to libraries, ordered books, and got tons of hands-on experience by pulling things apart," Ackermann told an interviewer for *Tape Op* in 2014. "I failed many times. I would read books and not understand a word of it, but eventually pieces started to fit and make sense. It took maybe a year just to teach myself how to solder…I had no one to guide me."[191] After college, he experimented more with circuit bending and modifying guitar pedals, which led to making prototypes for his own pedals at home in Fredericksburg, Virginia as a way to earn extra money for a trip to Europe. The designs were successful enough that he continued producing them, while also employing the effects as a bassist in Skywave, a noisy, shoegaze-inspired rock band that stood out in the local music scene. As he reminisced with a former hometown resident:

[191] Maiolo, Alex. 2014. "Interviews: Oliver Ackermann." *Tape Op*. http://tapeop.com/interviews/104/oliver-ackermann.

> It was a tough time…. Nobody was into that kind of music in Fredericksburg, but we always tried to push the envelope by experimenting with volume, film and lights, and by rebuilding our guitars and amplifiers to achieve new sounds. We were just bored and had nothing better to do, so we decided to create the music we wanted to hear. Skywave was like screaming from inside a deep hole or a protest against silence. (Sharp 2012)[192]

Ackermann planned a move to Brooklyn in 2003, as business began taking off.[193] There, he joined a new, similarly-influenced rock band, A Place to Bury Strangers. The band eventually developed an international fan base, due largely to critical acclaim and hype on taste-making music websites such as *Pitchfork Media*, followed by years of grueling tour schedules and a solid recorded output grounded in a dark, lo-fi, wall-of-sound aesthetic. The growing popularity of the band and the company appeared to go hand-in-hand, as press for one entity consistently mentioned the other. Through no insistence of his own, music bloggers both delighted in and cooled towards this premise. In 2012, one of them wrote, “There's no denying that A Place to Bury Strangers’ Oliver Ackermann knows his way around an effects pedal; pretty much every review of the New York noise-rock trio becomes a de facto advertisement for his guitar-gadgets company, Death by Audio.”[194]

The business found a home base in a converted warehouse located at 49 South 2nd Street in Brooklyn’s Williamsburg neighborhood, on a mostly industrial block around the

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192 Sharp, Elliott. 2012. “Interview with Brooklyn Band A Place to Bury Strangers.” http://www.redbullusa.com/cs/Satellite/en_US/Article/Interview-With-Brooklyn-Rock-Band-A-Place-to-Bury-Strangers-021243234592665.

193 This initial visit took place on March 28, 2009, and early information about the venue is culled from this interview unless otherwise noted.

194 Album review of *Worship* by Stuart Berman (2012) for *Pitchfork Media*. http://pitchfork.com/reviews/albums/16750-worship.

corner from the abandoned Domino Sugar factory. He teamed up with Matt Conboy, a recent college graduate who had studied writing rather than electronics but was eager to take on a musical project. The pair quickly realized that fulfilling orders from scratch was a highly chaotic way to do business, so Conboy began to handle more of the business transactions, leaving Ackermann to spend his time designing pedals. Once more space in the building opened up, they experimented with hosting concerts to pay the rent, and by 2007 they realized they had a bona fide (if legally questionable) performance venue on their hands. Suddenly the sole group of tenants on that floor, Death by Audio became its own DIY community. Bands cycled through the venue and rehearsal room, friends were hired to sell concert tickets, and a short-lived record label was launched. Employees of the pedal business were (and are) typically friends or housemates who are instructed in tasks such as soldering or clipping wires, and they work on temporary or sporadic bases, as they often pursue careers as musicians that requires touring for months out of the year. One such employee was Travis Johnson, guitarist/vocalist for the band Grooms, which rehearsed, recorded, and performed at Death by Audio countless times in the intermittent years. Johnson was at work during my first visits, and in 2012 I learned that he had joined Ackermann and Conboy as a "partner" in the business, taking on a substantial role in the construction and repair of pedals.[195]

[195] The pedal business is an LLC, while the venue was run under-the-table until filing as a non-profit in April 2008. "They didn't utilize it to the max capacity. I think it was more just a protective measure to have that legal end if required," says Stephanie Gross, a friend who helped them file for non-profit status in exchange for free entrances to performances. She says that the venue was able to cover its own costs, so they never applied for grants, although she would have liked to see this happen (Interview, February 2015).

In order to run a staunchly DIY endeavor, Ackermann insists that he never pays to advertise his business, aside from a few initial press releases in its earliest days, and its success has been largely a word of mouth phenomenon. Sales soared unexpectedly high in 2009, however, due to two factors: a *Guitar World* magazine feature on Death by Audio and A Place to Bury Strangers (May 2009) and U2's guitarist, The Edge, professing his fascination with the pedals in high-profile interviews in music magazines like *Rolling Stone* (March 2009), *MOJO* (November 2008), and *Q* (October 2008). Rock bands Wilco, Spoon, Nine Inch Nails, and My Bloody Valentine are among others said to have bought the pedals.[196] In early 2010, my field notebook read: "As demand grows, Death by Audio may be poised to outgrow its humble beginnings, a situation that challenges its homegrown autonomy" (Flood 2010). But as of my departure for Berlin in 2012, operations had not substantially changed; it seemed as though the pedal business had adapted to the demand rather than outgrowing it and that, together with the rest of the venue, it would carry on indefinitely as a cornerstone of the local DIY music scene—that is, until a widely publicized real estate debacle abruptly uprooted the space in November 2014. As I explain in more detail below, the DIY magazine-turned-media conglomerate Vice bought the building, and Death by Audio was forced to vacate the premises. The news vent viral that Vice (a company that closely associates with Brooklyn's DIY scene but is now owned by Rupert Murdoch) had put the last remaining DIY venue in Williamsburg out of business, and the perceived battle between Death by Audio and Vice became metonymic for the decline of DIY in a post-recession, rapidly gentrifying Brooklyn.

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[196] This is also documented in Brad Angle's 2009 *Guitar World* piece, "A Place to Bury Strangers: Oliver's Army." http://www.guitarworld.com/node/2264.

Structures and Blueprints

In this chapter, I use Death by Audio as a case study through which I explore the relationship between the makers, technologies, and infrastructures that generated a DIY music technology scene in Brooklyn and allowed it to thrive from roughly 2007 (the year the Death by Audio performance venue opened) to 2014 (when it closed). My concern, however, is not just to sketch out a broader music scene but to examine how the "thing-ness" of Death by Audio's technologies (pedals, circuit boards, and the like) facilitated human relationships that in turn mirrored the sorts of connections forged by the technologies themselves. The guitar pedal, with its input and output connections bookending an electronic circuit, lies at the center of Death by Audio's social relations, as a physical connection between things (guitars and amplifiers), a physical connection between people and things, and a connecting source that facilitates ever-broadening social connections. By functioning as an open-ended act of experimentation and a means for technological and human connection, Death by Audio embodied the potentialities of DIY and Maker culture as well as the possibilities for further invention.

Brian Larkin calls *infrastructure* the "totality of both technical and cultural systems that create institutionalized structures whereby goods of all sorts circulate, connecting and binding people into collectivities" (2008, 6). In this chapter, I look at the relationship between the infrastructure as a totality and the concept and functioning of the "blueprint," a plan for making and thus human action. I discuss three kinds of blueprints: an electrical schematic, which is a plan for the circuit (in Death by Audio's case for building guitar pedals); an architectural blueprint, or a plan for building in a space; and zoning blueprints, which regulate types of structures and the activities that are allowed to go on within them.

I view the blueprints discussed in this chapter as agents engaged in dynamic processes of creative flows. Blueprints, as plans, are generally thought of as static entities that structure design; in contrast, I argue they are a part of a broader "political ecology of things" (Bennett 2014) and actors in their own right.[197] Blueprints can be highly malleable, in the sense that design is not a linear process.[198] They are not only "things," as in sketches on paper, but they are plans for *action*. A prime example of this is with prototyping: as we shall see, electrical schematics, along with circuit designs and pedals as completed entities, are shaped and reshaped in a "dialog" between—at the very least—Ackermann as designer, the other employees, the electronic components, the electricity, and users who may decide/discover that the pedal needs repair, thus opening the pedal and bringing the schematics back out. On another level, this prototyping exists within the dynamics of the built environment, which changes based on demolishing or rebuilding walls, as well as in the face of moving locations altogether. Furthermore, blueprints of the neighborhood determine where and how artists can go about their work; even these regulations are not fixed, as the rezoning process shows.

Although I use Death by Audio itself here as a kind of blueprint for understanding

[197] I refer here to the work of many scholars who have grappled with or positioned objects as having a kind of agency (e.g., Bennett 2014; Bryant 2011; Latour 2005; Morton 2013). I am interested in the blueprint as a configurable map for human action, as a rhetorical and aestheticized representation of knowledge, and in the ways that blueprints facilitate community and social relations.

[198] See Scarduzio, Gianni, and Geist Martin 2011 on how blueprints relate to ethnography itself, in which shared "principles or characteristics," or "core epistemic values," are drafted into "something that inspires, structures, and evolves through a process…" (449).

the relations between DIY music technologists, the objects they build and use, and the built environment, Death by Audio is unique amongst my interlocutors in one key way. As part of the rock scene, its participants mobilize a specific rock identity that, for example, many of those in Maker culture do not; the "indie rock band"[199] is at its conceptual core, and, as we shall see, the effects pedals built there are most associated with rock guitar playing, even though they need not be used for this purpose. Musical ensembles that perform in the venue are most typically (but not always)[200] bands with a rock background. The venue booked groups that have additional options to play in larger venues, but they also took chances on lesser-known groups with little or no audience (or the likelihood of appealing to one); on some occasions, I have been one of a very few people listening. The "house bands" at the heart of the venue, A Place to Bury Strangers and Grooms, could best be described as "noise rock" or perhaps "noisy rock"[201] despite differences in timbre and songwriting; I would argue that this aesthetic preference is also reflected in the nightly bookings (and especially in the choice of Lightning Bolt as the last band ever to headline there). Moreover, their best-known pedals are "fuzz" pedals named through bombastic language and images of chaos and destruction (e.g., Fuzz War,

[199] "Indie," as in "independent," can express (extremely tenuous) conventions of genre, forms of music production and participation, and an attitude about such practices. As Shannon Garland states, "Indie became associated with an ethos of counterculture, DIY, respect for social relationships over profit-making and the pleasure to create and do over a market-driven bottom line" (2014, 8). For Death by Audio, the bands perhaps best described in *Our Band Could Be Your Life* (Azerrad 2001) served as forerunners and frameworks for the desired aesthetics and practices. These bands (e.g., Sonic Youth, Mission of Burma, Fugazi) flourished between 1981-1991 and set the tone for a post-punk take on American underground rock music.

[200] I have also seen hip-hop and experimental electronic music performed there, though not in the vein of university-based computer or electroacoustic music.

[201] See Novak 2013 for more on the gradations of noise in underground music.

Supersonic Fuzz Gun, Apocalypse, Soundwave Breakdown) to translate the desired sounds. Thus, "noisy rock" emerges as an aesthetic and a subgenre that both produces and is produced by Death by Audio.

Despite being firmly rooted in the indie rock scene, the temporality exhibited by the genre-making at Death by Audio was multidirectional in that it did not exhibit a clear teleology.[202] Although the "house bands" drew upon specific groups for inspiration, the broader Death by Audio scene, I suggest, embodied a way of looking back that was itself conditioned by the knowledge that at some point in the near future the space would be closed down. The temporality of genre here emerges in tension with the contingency of zoning and the built environment. Nevertheless, writing from a time after the venue has closed, the building of guitar pedals still continues, and thus a kind of perpetuation of genre is facilitated by the act of making itself.

Finally, I also consider in this chapter the tensions (particularly gentrification) that led to its shift away from the Williamsburg area that was so central to the DIY community in the late 1990s-early 2000s. Somewhat resembling broader historical patterns of mobility within New York's visual arts world (Fensterstock 2013), the underground music scene has been pushed far to the outskirts of Brooklyn. Death by Audio was an outlier in this sense, surviving in what became one of the most increasingly expensive neighborhoods until 2014. This artist migration generally comes at the heels of the displacement of other racial, ethnic, and socioeconomic demographics; by the time that artists, too, are displaced, the social fabric of a neighborhood often looks radically different than it did a decade prior. Thus in what follows I also turn to manufacturing and

[202] This reading of temporal dimensions was influenced by a lecture on genre delivered by Georgina Born, April 2015, Columbia University.

artisanship to see how employment opportunities are clustered in northern Brooklyn, which tend to favor creative entrepreneurs but hire few workers.

Building Pedals, Building Community: Blueprints from Micro- to Macro-level

An electrical schematic is the symbolic representation of the circuit, drawn out on paper as a blueprint for the design. Schematics underlie the very existence of DIY music technology, yet they are used as tools in different ways depending on participants' needs. More specifically, for Death by Audio, schematics structure the relationships between the components that make up guitar pedals, but individual musicians' interactions with them vary. Beyond electronics, a schematic refers to a diagram or model that represents the elements of a system using abstract, graphical symbols. Its root word, *schema*, means "shape" or "plan" in Greek. In cognitive psychology and the sociology of culture, meanwhile, schemata (the plural of schema) describe mental frameworks created to help organize information, while information considered irrelevant is omitted from the frameworks; they are "both representations of knowledge and information-processing mechanisms" (DiMaggio 1997).

A schematic, as a circuit diagram, then, is a technical illustration of the design of a technological object in which the circuit is represented graphically. Each electrical component has its own unique symbol, and its connections to other symbols are shown. It need not depict the actual, tangible layout on a circuit board, but rather privileges the functions of components and the relationships between them; any details inessential for signal flow are generally omitted. The symbols, though largely held to international standards, have changed depending on time and place but are always supposed to represent some fundamental aspect of the component. Schematics allow access to essential information about the way electronics work; this information, in turn, allows users to create, share, and reconfigure electronic devices.

The way in which someone interprets a schematic affects understandings of design more generally—not only the design of the device at hand, but also what other new devices can be dreamed up. Historian of science Edward Jones-Imhotep (2008) has surveyed the 1950s debate over how to standardize a graphic symbol to represent the newly invented transistor. This seemingly simple task became a prolonged journey into the nature of icons and the representation of scientific knowledge, in which schematics became contested sites. The circuit diagrams of the 1950s were meant to show *functional* relationships between components, not their *spatial or physical* relationships; meanwhile, the electronic symbols they employed had more work to do—they needed to show both form *and* function. In other words, the latter was responsible for representing both stylized, abstracted versions of the components' physical forms and their suggested functions, tied together through analogies and metaphors regarding circuit flow, all rendered graphically. Each time people created new symbols for the transistor, Jones-Imhotep argues, the meaning of the symbols "shifted, shaped each time by different visions of how schematic diagrams functioned: as taxonomical expressions, as social texts, or as heuristic devices" (411). The debate brought up many questions and anxieties about schematics: What are they—really? How did they carry out their functions? What norms should they follow? It forced scientists to confront what can be said to exist within these drawings. What are the essential qualities of the components? And how can one capture the “essence” of a material device in graphic form?[203]

Jones-Imhotep views schematics as a “‘paper tool’ used to think through the workings of material artifacts before they took physical form…” (431). Alternatively, they are “not so much the thought-things of individual engineers and designers, but…public artifacts meant to communicate and coordinate among the various groups implicated in the construction of artifacts” (431). Jones-Imhotep concludes that, on the one hand, “Drawings were the places where electronics were first (imaginatively) assembled, erased, operated, and reconfigured, and therefore a key site for contests over the meaning of the devices that went into them” (450). On the other hand:

> Drawings were not just sites where concepts and ideas were worked out—they were instruments through which materials and objects gained meaning and acted back upon the drawings themselves. Debates over symbols were about devices; debates over devices returned once again to symbols and diagrams. They forced articulations of what kind of things electronic drawings ought to be…. (449)

Anyone unable to interpret the schematic, therefore, was traditionally excluded from this particular layer of communication about the object being built. However, DIY music technology, as a vernacular practice (including pedal building, circuit bending, and other explorative engagements with circuits), highlights musicians’ pluralities of experience with technological objects and understandings, as non-experts navigating their way through a morass of tools, techniques, and reference points.

At Death by Audio, the schematics outline the basic structure of each guitar pedal, while mediating relationships between builders and the sounds they produce. Ackermann, on the one hand, learned to work with these by modifying existing designs available

[203] See also Jonathan Sterne’s 2012 study of the MP3 as an audio format for a parallel discussion of the standardization process of technologies.

online and eventually created sounds distinctive enough to sell as his own; the other pedal builders did not necessarily have this background. DIY music technologists have wildly varying relationships with schematics, and the Death by Audio workshop space reflects that diversity of experience. Conboy and Johnson, on the other hand, have practical knowledge of guitar pedals that is predicated more on the excitement of the sounds they produce and the attachments to rock music they convey. Johnson, for instance, uses many of their pedals to sculpt the sound of his own music, but his knowledge of the electronics has emerged on a need-to-know basis. He began assisting at Death by Audio with no knowledge of electronics—how to solder, how to read a schematic—but as his involvement has increased, he began wanting to learn more about how to help with testing, design, and development (though admitting he feels "a long way" from that goal):

> Whenever we do stuff like this, we don't need the schematic anymore because it's all printed out on here [the PCB]. But it is sometimes helpful to have the schematics around if we're like, "What's the problem here?" And then I can pull out the schematic and be like, "Is something connected that's not supposed to be connected?" Like maybe there was a misprint on the board, which happens every once in a while. [….] Any time I've had to read schematics, it's been a combination of looking stuff up online and trying to read up on electronic design and engineering basics—very basic stuff—and then working out, like, "here's a schematic," and then try to build that on a breadboard and see if you understand what it *means,* and how everything has to be connected to everything else, and what order. But anything I learned, I learned either here or through here—*because* of here—and I went home and looked stuff up because I was interested. (Interview, March 2015)

Online, meanwhile, users of existing websites circulating advice about building pedals create their own schematics. A search for "Death by Audio clone" brings up approximations of official designs, in which users try to reverse engineer the pedals. Often, a customer will open up a purchased pedal and retrace the physical circuit connections to produce her or (more likely, given the demographics) his own version, either to demonstrate the individual's own knowledge of electronics or out of a desire to save others money by even further "DIY-ing it." Thus, as a whole, schematics function to forge *connections* dually at the level of the electronic, through signal flow, and the social, whether in the brick and mortar site of the workshop or the virtual world of circulation.

A second type of blueprint, the layout of the venue itself, acts as a conduit connecting the built environment to a broader social infrastructure. Aaron Allen (2011) writes that, "architects and urban planners use *built environment* to refer to humans' manufactured world of dwellings, buildings, infrastructure, constructed landscapes, and urban social spaces, as well as the interactions of these places with each other and humans" (392; his italics). On the one hand, Death by Audio remained somewhat concealed behind barriers of privilege and secrecy; the door was not marked, the events were not advertised, and entrance was a reward for possessing enough "subcultural capital" to know it existed (Thornton 1996). Even people who entered the performance venue might not be aware of what the rest of the building complex held. On the other hand, the previous barriers could be viewed as merely protective measures to ensure the sustainability of the space.[204] In my experience, once the Death by Audio community came to know and trust a visitor, the community was highly inclusive. Their goal was to support independent musicians, and this building was one node in the DIY circuit for doing so. What truly made Death by Audio unique among its ilk, though, was the pedal workshop and the parade of technology on display. Once inside the living area, the floor

[204] I mean "protection" in two senses: first, against the hypothetical threat of a venue attracting a crowd that is too large for the confines of its space; second, DIY venues frequently fly under the radar because they are not "up to code" in one or more facets, and there could have been aspects of questionable legality in this space (in terms of occupancy, alcohol, and other issues of city regulations). I did not pursue these latter questions in order to minimize risk to my interlocutors.

plan was fluid enough that every aspect of life bled into another: parties could be heard in the bedrooms, projects were laid out in the kitchen, and the door to the workshop (if it even had one) always seemed open. Having someone disappear mid-conversation only to be later found building pedals was a normal occurrence. In this same sense, the pedals bled into the bands' music, and the sonic needs of the bands bled into the pedal designs. The recording studio was a small room between the workshop and the lounge area. Walls were physically reconfigured over time: Ackermann (with the help of this community) built and remodeled subdivisions within the large, empty warehouse space. As construction workers knocked down walls in preparation for Vice Media's arrival, the skeletal remains of Death by Audio's form and function went with them, although the community oozed out into new terrain, an as-of-yet unformed potentiality. Overall, they were carving out a sphere of sociality focused on the DIY ethos and facilitated by the pedal business (without which the rest of Death by Audio would not exist).

As a third blueprint, the structure (and infrastructures) of the neighborhood helped shape the form that Death by Audio took. A zoning process (to which I will later return) allowed the warehouse that housed them to remain intact, even as Vice Media remodels it for new purposes, while the rezoning of much of the surroundings from manufacturing to residential districts facilitated changes in the character of the neighborhood that led to the venue's demise. Meanwhile, as wee shall see, the city's focus on developing other areas like the Brooklyn Navy Yard in order to *encourage* a "new manufacturing" trend reflective of small-scale artisanship influenced the pedal workshop's next move. Brooklyn's DIY/underground music scene—a circuit that included other venues over the years such as Silent Barn, Market Hotel, and 285 Kent—enabled many local bands to thrive and hosted musicians in intimate performance contexts. Concerts at Death by Audio's venue were all ages (rather than the 21+ rule that most venues uphold in order to run a full-service bar inside), and they were posted on a website called "entertainment4everyone," as well as on the bands' websites and Facebook pages, where anyone who had heard of the site or had "friended" the bands could keep up with bookings. This circuit of bands also sometimes purchased the guitar pedals or came through Death by Audio for rehearsals, parties, or other events. Finally, for a while, Williamsburg's status as an artist hub in the early 2000s brought musicians and audience members to the neighborhood, and the venue's exact location (just barely considered "walkable" from the L train's bustling Bedford Avenue stop) enabled it to be accessible yet largely hidden from view.

I contend that this series of layered blueprints that Death by Audio physically and conceptually inhabited lent itself to what Tim Ingold calls a "dwelling perspective," in which dwelling is "not merely the occupation of structures already built…. It rather signifies that immersion of beings in the currents of the lifeworld without which such activities as designing, building and occupation could not take place at all" (2011, 10). To be clear: *the push-and-pull of structure and seepage, of dwelling amidst currents, is a kind of flow of becoming* that I discussed in the introduction. To better understand this process of prototyping sounds, materials, and human lives, I turn now to a discussion of the deeply held significance of guitar pedals and the DIY ethos for my interlocutors, set within the recent history of northern Brooklyn's of socioeconomic shifts.

Technologies of Retro-Future Timbre: Current Uses and Brief History of the Guitar Pedal

Guitar effects pedals are, most simply stated, sound effects units made of an electrical circuit encased in a metal or hard plastic box. They are sometimes known as "stompboxes" due to the physical act of triggering one by stepping on a button built onto a metal box enclosing the electronic equipment; guitarists occupying both hands in performance find it easiest to toggle the button with their feet, but they and other instrumentalists employing pedals are also known to get down on the floor and "play" a pedal board with their hands or to place one on a table for closer access while standing. In the context of DIY music technology, I view guitar effects pedals as extensions or augmentations of instruments. The practice and goal of building them is not so different from building amplifiers and other sound equipment as part of the sound production chain. The pedals can be constructed for a number of purposes: 1) as "clones," in which someone either buys a pedal-building kit online or experiments with building their own circuits to approximate the sounds of existing guitar tones; 2) by "tweaking" the circuits of existing models to alter the sound; or 3) to build entirely new circuits in search of entirely new sounds. Death by Audio produces some combination of the latter two methods. Let us sample the descriptions of their current lineup of pedals:

- **Soundwave Breakdown** "takes the idea of a screaming fuzz pedal and turns it inside out using specially matched transistors turned backwards..."
- **Interstellar Overdriver** "blast[s] your amp with sound" and "is designed to work the same was as old tube amps—the more you turn it up, the better it sounds."
- **Fuzz War** features a "specially designed multi-curve shaping filter which changes the timbre of the pedal from super deep bass sludge to screaming highs."

Figure 37. Screenshot of Ghost Delay pedal
from Death by Audio's website

- **Supersonic Fuzz Gun** promises to let you "create your own tone," asking: "Need to melt peoples [sic] brains with supersonic chaos? Want a different sound than everyone else?"
- **Reverberation Machine** is a "synthetic atmosphere creator" intended for use with any instrument beyond just the guitar. One might equally use this for "simulations of vintage [amplifier reverberation]" and for "creating exciting new reverberation soundscapes that span from subtle to wild."
- **Robot**: a "low fidelity 8 bit pitch transposer" for turning melodies into "resynthesized robot jargon." It also has "no feelings what-so-ever."
- **Apocalypse** claims to build on "years of fuzz innovation" to combine "5 unique fuzz circuits…with a sweepable frequency equalizer."
- **Ghost Delay**: "3 echo circuits cascade into each other to bring an extremely organic and versatile dream machine to your fingertips. […] Blend and master volume controls give you the ability to tame back the insanity or bring it forth with a wall of screaming dying ghosts. The amount of sounds produced by this thing and their originality are uncanny. It could be the start of a new sound. It could be the start of a new band. Your guitar, vocals, keyboard, drum machine, bass, clarinet never sounded so creepy!"
- **Echo Dream 2** is another delay pedal, for which "the fuzz can range from subtle overdrive to ballsy fuzzstain and bring upon satans spawns to do the mopping up [sic]." [205]

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[205] Full versions of these descriptions and accompanying sound samples are found at: http://www.deathbyaudio.net.

Moreover, the *guitar* in *guitar effects pedals* is sometimes a misnomer: any instrument with an audio jack can connect to the pedals, and thus many experimental instrument builders incorporate homemade or store-bought pedals into their performances, either as an essential extension of the instrument or as part of a rotating cast of tools for timbral experimentation. Thus, guitarists will often specify "guitar pedals," whereas other instrumentalists might refer to "effects pedals." I will use the term "guitar pedals" in this chapter, as that is Death by Audio's specialty, but as seen above, even they have acknowledged this broader instrumental appeal in the descriptions of more recent pedals. This experimentation falls under the heading of what avant-garde musicians would call "extended techniques," or nonstandard ways of playing or singing in the service of exploring new timbral realms.

Guitar pedals in their stompbox form are an emblematic technology of rock music, yet one shielded from public view. Since pedals are cloistered at the bottom of the stage, audience members who do not know to look for them might not notice their presence. Guitarists, on the other hand, obsess over new and "classic" pedals alike, spending endless hours trying to emulate the sounds of their favorite bands or searching for a pedal that will make them sound unique. (Death by Audio caters to this latter crowd.) But despite their early-twentieth-century ubiquity, pedals in their stompbox form are also a nostalgic technology, nearly made obsolete by the rise of digital technologies, including computer software and effects boxes housing numerous sounds that can be digitally selected.[206]

[206] For instance, guitarists might now bring a laptop onstage and incorporate programs like Max/MSP to generate original custom-made sounds.

Of course, guitarists had experimented with altering the sound of the acoustic guitar long before the advent of effect pedals, often in response to a social or professional need.[207] While Les Paul and other inventors at first privileged an undistorted soundwave in their sound production and reproduction, innovation also abounded that upset the "tonal purity" of the instrument and its electric signal (Waksman 1999, 118). Musicians sought after artificial echo and reverb effects to create a sense of place and space (Doyle 2005). Amplification redefined the role of guitarists as soloists within larger ensembles, but it also enabled guitarists to imagine greater possibilities for creating sonic textures with their instruments. Beginning in the 1950s, some musicians produced "sounds that went against the established norms of amplification and creat[ed] the basis for a new set of sonoric values through the manipulation of volume, distortion, and other electronic effects" (147).

Muddy Waters experimented with pushing his amplifier to the brink of distortion, for instance. A bandmate of Bo Diddley's, meanwhile, referred to him as an "electronics freak," but Diddley insisted this was more out of necessity than interest, saying, "I didn't *buy* me no electric guitar; shit, man, I had to figure out a way to *make* me one!" (Waksman 1999, 150). Coincidentally, Diddley tinkered with amplifiers because he desired a cleaner, less distorted sound. "I spent *twelve* years tryin' to develop a good clean sound because I *hate* distortion," he explained. "You know what happened? Some

[207] When big band music gained in popularity, for instance, it became necessary to be heard within the context of a large ensemble. Engineers, instrument-makers, and musicians of the 1920s and 1930s began to challenge the guitar's designation as a purely rhythm instrument by experimenting with electric amplification, and George Beauchamp and Paul Barths's 1931 "Frying Pan" lap-steel guitar contained an electromagnetic pickup as the first commercial form of an electric guitar.

guy built a *fuzz-pedal*!" Diddley went on, however, to seek out many variations of guitar effects, from tremolo to overdrive (151). Timbre thus emerged as a site for establishing individual expression and identity in music-making, a process that was made easier by the creation of new sound effects.[208]

The first stand-alone sound effects were rather heavy and worked inconsistently; they were better suited as built-in effects on larger amplifiers. Therefore, the introduction and eventual incorporation of transistor technology revolutionized the capabilities of standalone effects, paving the way for individual guitar effect pedals that saturated the market in the 1960s and 1970s.[209] The post-World War II era produced a swell of electronics hobbyists, as facilitated by easily accessible parts from war-surplus stores, and the 1960s was a decade of technological innovation due to the recent commercial availability of electronic components such as transistors and their counterpart battery-powered electronic devices. A do-it-yourself phenomenon sparked in mid-twentieth-century music technology following the emergence of consumer electronics via stores such as RadioShack, the ubiquitous chain which first targeted ham radio enthusiasts and

[208] Although beyond the scope of this dissertation, the expression of racial and class issues is also tied to the development of the electric guitar and related sound effects. Waksman also acknowledges the "…racial subtext here within which the primitive stands for African American influence upon electric guitar performance, whereas the technological stands for white contributions" (1999, 4).

[209] A transistor is an electrical component used to modify power output by either amplifying or switching the input signal. By 1960, the modern transistor was firmly established as a type of consumer electronic component—an instantaneous-acting replacement for the warm-up delay required by vacuum tubes—and scientists continued to make slight improvements in its integration into circuits over time (Brinkman, Haggan, and Troutman 1997; Riordan and Hoddeson 1998). Transistors effectively made low-powered electronic devices smaller, more portable, and more convenient. In guitar pedals, transistors also provide the ability to add gain to the electrical signal, thus allowing for effects such as signal distortion.

offered an assortment of electronic components, and the availability of self-assembled hobbyist kits (e.g., Robert Moog's transistorized Theremin kits).

The 1960s ushered in the first widely used guitar effect pedals. Now that the electric guitar and its amplification had been honed, fuzz (overdrive/distortion)[210] and wah-wah (voice-mimicking) pedals began to appear.[211] The Maestro FZ-1 Fuzz-Tone, introduced in 1962, is recognized as the first transistorized guitar effect and was used by Keith Richards on the Rolling Stones 1965 classic "(I Can't Get No) Satisfaction," although Richards was reportedly not a fan of its sound at the time. Such effects were popularized especially by Jimi Hendrix, who incorporated them into his playing style to experiment with a dense sonic palette that inspired countless other rock guitarists (Whiteley 1990).

By the late 1980s and early 1990s, however, multi-effect digital signal processing models threatened to overtake the market completely, with products like the ART ProVerb and the Line 6 POD amplifier modeler combining myriad sounds into one compact item. But guitarists never completely abandoned the individual effect pedal. A market for vintage pedals proliferated their regeneration by production companies; it also spurred the production of "clones," pedals created by amateur builders intended to

[210] It is clear from Death by Audio's catalog that "fuzz" is at the heart of their design. While "overdrive" generally refers to a low-gain version of "distortion" that results from "pushing" an amplifier, there are subtle distinctions between these terms and fuzz. Specifically, fuzz "creates a tone by boosting the signal within itself until the signal distorts […] way beyond what an overdrive will typically do, [creating a more compressed signal output]" (Gallagher 2012, 161). Fuzz effects also use transistors, as opposed to diodes, and are often "quite simple circuits [with perhaps] less than a dozen components" (ibid.).

[211] The former "flattens the top of the signal waveform and in the process adds additional harmonics," while the latter "modulates the high harmonics up and down periodically, giving rise to a wah-wah sound" (Parker 2010, 163).

recapture or surpass the elusive tones of the originals.[212] Some of these builders simply create pedals for their own enjoyment or for use by their friends or bandmates, while others hope to eventually sell their own designs. A whole cottage industry has evolved around DIY effects pedals, from message boards (e.g., DIY Stompboxes, I Love Fuzz, Experimentalists Anonymous, Gearbug) to websites selling parts and kits (e.g., Build Your Own Clone, Pedal Parts Plus, Small Bear Electronics), some of which are explicitly for pedals and other for a mix of pedals, circuit bending, and other DIY audio projects—not to mention materials available on broader Maker sites like Sparkplug and the New York-based Adafruit Industries.

In addition to posting reviews, seeking advice, and selling materials, people use these websites to circulate electrical schematics (for instance, sparking a debate over the value of the Total Sonic Annihilation pedal, a user reverse-engineered the pedal by creating a circuit that approximates its sound and then posting the schematic on a message board).[213] For schematics that are not self-designed, this circulation raises some questions of legality.[214] Some schematics are for patented devices, and even if these were invented decades ago, people reposting them are likely liable for copyright infringement. However, "tweaks" or "modifications" of circuits that are drawn as a new graphic are likely to fall under the radar, both because copying would be hard to prove and because

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[212] Websites such as Build Your Own Clone offer DIY kits for sale, which bundle the materials needed to approximate the sound of "classic" pedals, as well as individual parts, tools, and widely popular forum discussions.

[213] See, for example: http://www.electricalaudio.com/phpBB3/viewtopic.php?f=5&p=1515666.

[214] For this reason, I have omitted images of schematics taken during my fieldwork from this dissertation.

the business for guitar pedals is not profitable enough to require lawyers searching the internet for copyright infringement. (The schematic can be copyrighted to limit its distribution, while the design for the invention itself would be patented.)

The more successful of these amateur pedal builders might additionally make their own unique designs, as well. These “boutique” pedal companies—meaning “hand-built in small batches” (Fenn 2010, 68)—can today command an average price of around $150-300 per pedal. John Fenn, who studied improvisational practices in the “culture of boutique pedals” in the U.S. and online from 2007-2009, calls it a “relatively small yet vibrant niche of music technology” including participants “with a wide range of genre tastes, musical experience, political views and technical backgrounds….” (67). He finds two primary groups of builders: “those who have electrical engineering backgrounds (however informal) and those who work from a more intuitive and experimental position,” the latter of which he calls “DIY educations in pedal building” (ibid.). Death by Audio’s pedal business fits into this latter group: they include participants spanning these backgrounds (leaning towards the informal and experimental takes on electrical engineering). In addition to calling the pedals “DIY,” they, too, sometimes refer to their business model as “boutique”; that they use these words interchangeably is of interest because the former connotes a purposeful *separation* in ethos and production from the mainstream way of doing business, while the latter (as a small, specialized store appealing to sophisticated tastes) carves a niche for them *within* but *above* the mainstream, with an air of exclusivity.

Construction and Technoaesthetics

The design of a guitar effect pedal hides its inner workings but reveals even more in its overall construction. For a pedal capable of creating a single sound effect, what outwardly appears is a small metal enclosure with a few knobs, buttons, and perhaps lights (or more accurately, potentiometers, switches, jacks, and LEDs). "In" and "out" jacks allow the guitarist to connect a cable stretching to the guitar on one side and to an amplifier on the other side. The controllable parameters include, at the very least, an on/off switch and volume level. The protruding light emitting diodes (LEDs) indicate when the device is turned on and has ample battery power. This "box" is likely to be rectangular, maybe 3" x 5", and two pounds in weight, although liberties may be taken with the shape and size.

The pedal's inside houses a variety of electronic components, depending on the specifications of the electrical circuit at hand: transistors, resistors, capacitors, diodes, and more. These components are inserted into a printed circuit board (PCB), the ends of their flexible wires poking through the thin, often rectangular piece of plastic characterized by a matrix of tiny holes, and then soldered together. Little blobs and lines of molten solder streak across the PCB, connecting the components into the electrical circuit as specified by the designer's electrical schematic. Surrounding the PCB, a mass of colored wires tangle, presenting an image of the technology that is chaotic and unfinished, yet often portrayed as aesthetically pleasing among enthusiasts.

To plan out and construct the pedals, there is generally a trial and error stage (of an initial design, testing, and reconfiguration) in which Ackermann and the group dream up a concept for a new product, Ackmermann alone designs a schematic, tests the design

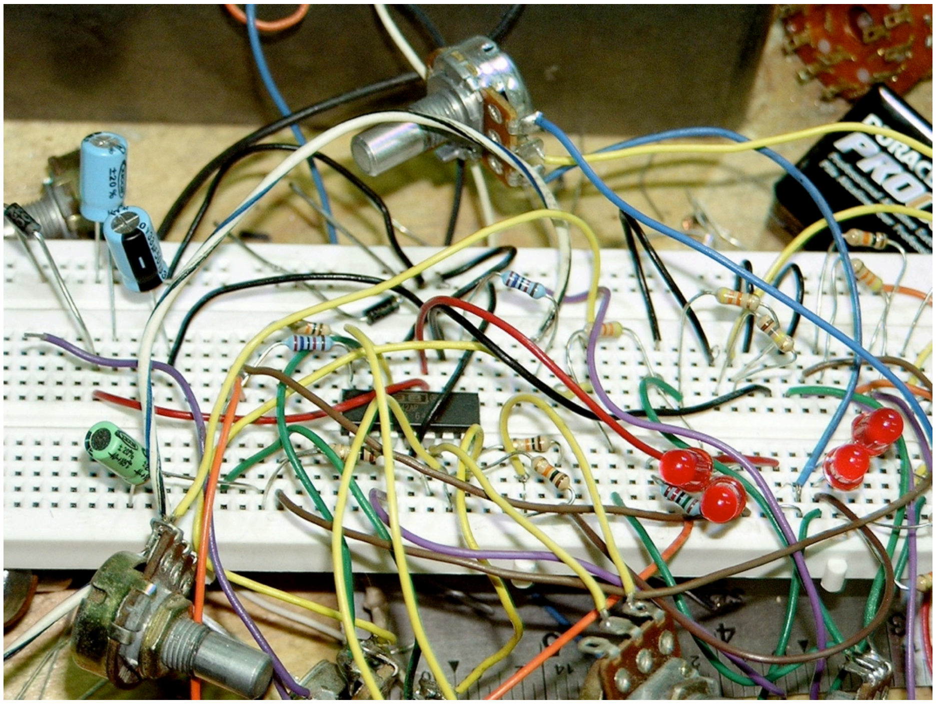

Figure 38. Prototyping on a solderless breadboard at Death by Audio, March 2009

on the solderless breadboard, and creates a customized PCB on a software program called Eagle. The group orders shipments of the PCBs, then builds a test-run upon arrival to see if they function as intended. Johnson describes two stages of pedal building: prototyping and production. In the prototyping phase, he says:

> It will be like, "Here's a breadboard that works this way. Come see what it sounds like." Play it, and then maybe get a prototype board drawn up of that. Then, build that out, and it will be printed with 'here goes this resistor' and 'this is this cap[acitor],' and it's got all the traces on it, so we don't have to wire anything.[215] And then test that, see if it's got any problems, any issues. Go through it and see if we can make it better, if it needs to get better. Order another round of prototypes if we need to, which we usually do, and hopefully get it ready to go and start production at some point. (Interview, March 2015)

[215] The "traces" Johnson refers to are etched into the custom PCB design, eliminating the need to solder wires to connect each component. Wires are needed to connect components that reside off the board, however, such as switches and potentiometers that poke through the enclosure.

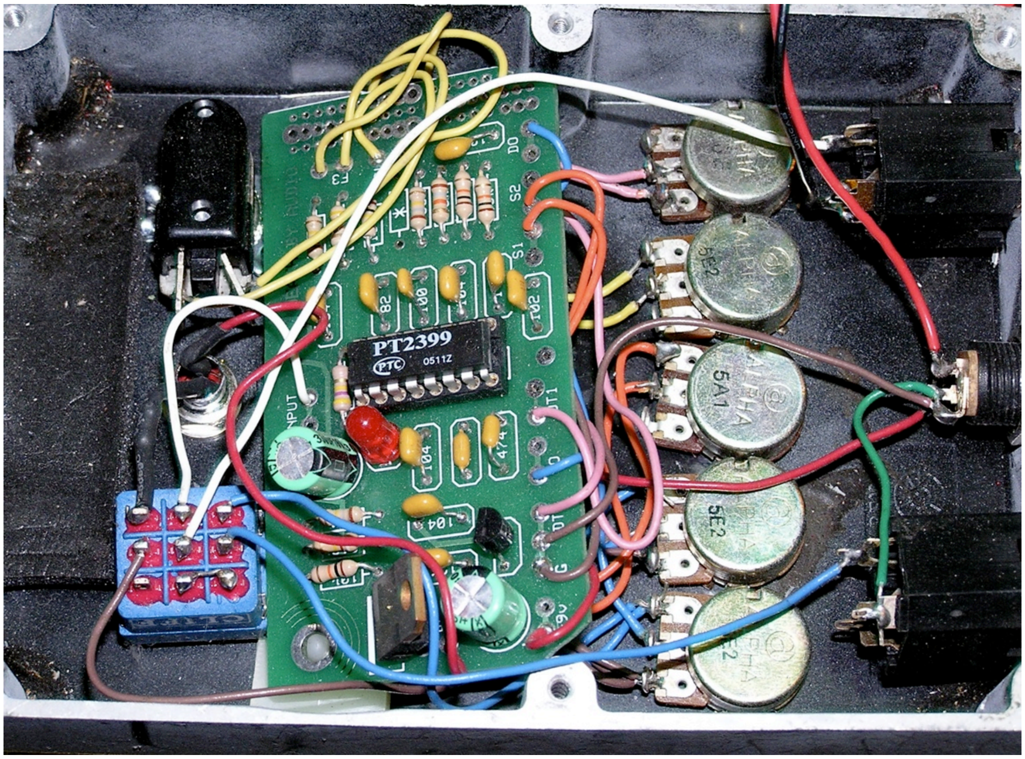

Figure 39. Inside of a Death by Audio guitar effects pedal, March 2009

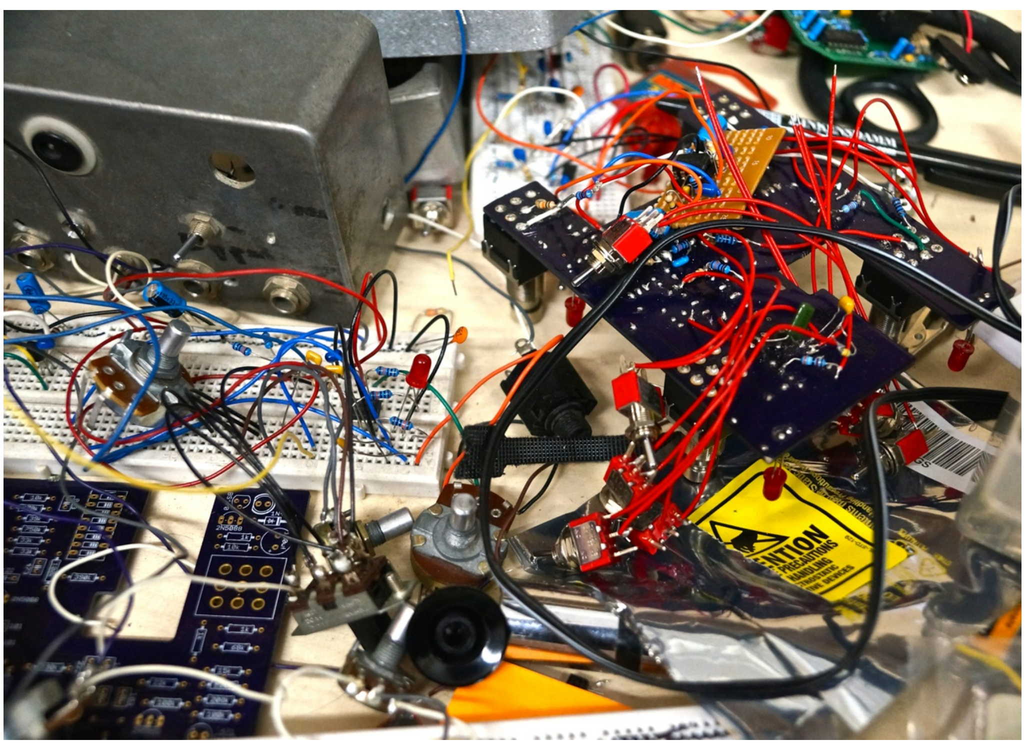

Figure 40. Death by Audio pedal circuits in various stages of prototyping, March 2015

Next, production consists of "populating the board," which refers to putting the electronic components into it, "soldering it, screenprinting the enclosures, ordering the enclosures, designing the enclosure, just everything about putting it from being an empty box to putting it all together, putting stomp switches and pots and jacks and all that stuff" (ibid.).

From concept to completion, guitar pedals emerge from a particular way of making sense of music and technology. I view technoaesthetics as a concept to mean shaping one's aesthetic judgments in terms of the technology one values and knows is available. This can entail privileging high-tech over more antiquated forms, but such is not always the case; indeed, DIY music technologists do not always clamor for the newest forms of technology. In many instances, they prefer analog to digital or lo-fi to hi-fi. Many of their sonic influences come from noise rock bands, avant-garde experimental music, and genres such as punk, post-punk, new wave, industrial, and shoegaze—what we might call *(un)popular* music, due to being rooted in rock and popular music sounds and structures while either seeking to experiment beyond those structures or claiming a niche audience rather than a wider audience. In effect, the technoaesthetics of DIY music technology are "aesthetics delivered through machines, constituting a specific fusion of appearance and utility" (Masco 2004, 368). Since the advent of recording technology, this logic is structured by a phenomenon called "record consciousness," as theorized by Theodore Gracyk (1996) and most concisely described as "a mode of experiencing musical reality and the standard against which a good performance is judged" (Waksman 1999, 149). In this view, practical and aesthetic musical choices are made with the recording device and the medium of the record always in the back of one's mind, thus shaping the outlook and the eventual content produced by all involved in the recording process. Consequently, record consciousness undoubtedly shapes the technoaesthetics at play when building DIY music technology.

The technoaesthetics of the guitar pedal hide its internal components and encase its circuitry, philosophically black boxing it. Its inner workings are widely accepted within a given population, such as guitar pedal consumers, who do not analyze its processes of transforming information—until the black box ceases to perform its intended function correctly or the consumer desires to use it in a different way. In such a scenario, the human-machine contact becomes far more interactive, and the user is forced to open the box and understand how it works—and the full realm of its capabilities—in excruciating detail. This process of coming to know the black box occurs among nascent guitar pedal builders (among other DIY music technologists), *as well as* more seasoned ones, such as in the earlier example of Johnson learning more about the machine through the repair process.

Wolfgang Schivelbusch discusses how the construction of technological innovations tends to conceal what is perceived as "the necessary, but 'ugly,' machinery beneath" ([1995] 1988, 174). In the case of guitar pedals, concealing the inside is mainly practical; the pedals must be ruggedly constructed to withstand harsh conditions on the road and stage. During a performance, the pedals are placed onstage but remain obscure from the audience's perspective. So, why are they decorated with so much care when they are just meant to be stepped on? The decoration of a pedal reflects how the engineers/designers desire it to sound and what imagery they intend for it to evoke. The name given to the pedal is an important signifier of its intended meaning and potential uses. From the 1960s onward, names like the Fuzz Face, Distortion+, or less transparently, the Big Muff Pi or Holy Grail have been synonymous with overdrive, distortion, distortion/sustain, and reverberation effects, respectively.[216] These names act as metaphors that come to represent the sonic qualities induced, translating the aural into text.

John Fenn, meanwhile, considers the stages of "inspiration, design, assembling, decoration, and even distribution" behind boutique pedals all as encapsulating the interplay between knowledge and creativity that uphold themes of both technoaesthetic[217] tradition and experimentation (2010, 67). He locates two realms of design in pedal building: the insides (circuits) and outsides (enclosures), noting that for most builders, creativity flourishes especially "at the intersection of circuit and graphics" (70). This building process becomes an improvisatory practice of "iterative creativity" based on gaining tacit knowledge through repetition and modification—combining "personal aesthetic or states of mind" (drawing on larger storages from a previously built "corpus of aesthetic-technical creations") with "experimental manipulations of elements from that corpus" (71).

For example, Death by Audio's first pedal was the Total Sonic Annihilation, a feedback pedal that combines all other sounds in a guitar player's chain of effect pedals into a new, customized effect. In other words, a guitarist with multiple other pedals plugs

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[216] The Big Muff Pi and Holy Grail are produced by Electro-Harmonix, a massive guitar pedal factory located in Long Island City, Queens. I plan to elaborate on the different business approaches to pedal construction by Death by Audio and Electro-Harmonix in future research.

[217] I am imposing my reading of Masco's term here; Fenn actually circumnavigates it: "technical and aesthetic" (2010, 71), "aesthetic-technical" (ibid.), "the ways in which affordances of the technology's aesthetics interact with use of the technology" (67).

each one into the next until they all reach the feedback pedal, which creates a "loop" that feeds back into itself. Originally produced commercially in 2003, even before the Brooklyn workshop began, it was once their most popular item (but is now discontinued as they move onto new designs). Ackermann did not invent this concept, but his particular arrangement of electronic components created a blend of available sounds that users called "distinctive," "insane," and "delightfully chaotic."[218]

David Novak explains the role of feedback loops for noise musicians (presumably those more "extreme" than A Place to Bury Strangers, but who likely maintain overlapping aesthetics), stressing the gradual "transformation" and "cumulative buildup of sound":

> The sound travels through every one of the effects [pedals] with each cycle, and the feedback fluctuates according to changes in the total system. A Noisician, then, does not use a pedal to "turn on" a particular sound (as when a guitarist steps on a wah-wah pedal to create a "crying" tone). Instead, a change to one effect changes the productive conditions of the whole system. [….] The process is something like magnifying and photocopying an image over and over again, until the details of the original form are totally unrecognizable. [….] It is important to recognize that the sound of this setup is not simply the result of the [instrument] "played" through the system; it is the sound of the whole electronic circuit overloaded back into itself. (2013, 147-148)

The website invites potential buyers to "stomp on the switch and destroy the world!" It continues in the following (unpunctuated) terms: it "smashes and crashes and bashes to ashes breaking and twisting and twirling and sputtering / Total Sonic Annihilation is for all of the noise makers, experimentationists, revolutionists, out there—

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[218] User reviews are available on guitar and electronics-related message boards, with user demonstrations posted on Youtube. Since Death by Audio does not advertise, word of mouth and message boards are the only way to hear about their products. For a sampling of reviews, see: http://www.gearbug.com/product_info/death_by_audio_total_sonic_annihilation.

not for the weak of heart." The website also stresses that the pedal is "totally unique" and durable: "built by hand with only the best electronic components and only the most extreme care…."[219] By "extreme care," they refer not only to the construction process but also to the full life cycle of the pedal (this foreshadows other forms of sustainable building to be discussed in the prior chapter); Ackermann and Conboy emphasize that they stand by their craftsmanship with a lifetime warranty, offering free repair with "no questions asked."

The Total Sonic Annihilation's "delightfully chaotic" yet handcrafted and durable nature is of particular interest here. DIY music technology appears to privilege two seemingly contradictory domains: control and lack of control. As we have seen with the micro_blackdeath noise synthesizer (chapter 2), the thrill of an unknown and unknowable "magic" inside of circuits is extremely alluring to my interlocutors, despite posing problems for recreating live performances. As one user notes, the Total Sonic Annihilation makes it "nearly impossible to duplicate a sound once you find one," while another states, "I want more control over my noise and with this I get none."[220] The unpredictable nature of the device can either be embraced or rejected. What does appeal to all users, prompting their decisions to purchase a device, are the DIY aspects in the form of quality control: handcrafting, high quality materials, and lifelong repair guarantee. Users want a unique sound that cannot be found elsewhere, a quality product,

[219] This information was posted on deathbyaudio.net, which I accessed in 2009-2010.

[220] These quotes are also from the reviews on http://www.gearbug.com.

and to support an independent small business rather than a mass production.[221]

The repair guarantee has caused some issues, however. According to Johnson, people would sometimes misunderstand how the pedal worked and feel they had been duped:

> The [Total Sonic Annihilation] only annihilates anything if it's got other stuff going into it, and so people would plug their guitar into that into an amp, and it would just sound like a guitar. And they were like, "This doesn't work, and I opened it up and there's not even a circuit board in there." But that's not what the pedal does. [….] The configuration of wires allowed for the pedal to cause other pedals that were looped into it to feed back on themselves. So, it would feed a delay back into a delay, or something. It would do it more with certain kinds of pedals than others, like anything that had a sound *after* the input sound, like reverb [or tremolo]. [….] And then you feed that in, and you're playing with the knobs on the other pedals and tweaking the sounds it's feeding in. So it can sound really nuts, but it only works if you know what you're doing. (Interview, March 2015)

Meanwhile, the Total Sonic Annihilation is screenprinted with images portraying explosions and sound waves. Noticing what I thought was a purposeful pattern of design as new pedals were introduced, I inquired about the visual aesthetic and learned that they are inspired by industrial design from the 1950s-1970s ("what people thought the future would look like") and "the excitement of modern art." Ackermann and Conboy stressed that graphics are an integral part of pedal building; players must to be able plug in and think, "This makes me imagine things." They also half-jokingly aim for a nihilistic style that is a "celebration of no talent," with "vibrant colors and flashy things" meeting a punk rock approach that is brazenly "anti-things." At the same time, the designs are about "urban camouflage" as far as "fitting into what's already there" in one's playing

[221] Guitar pedals differ from circuit bending in this regard for control, as discussed later and by Novak (2013, 165) because rugged durability and reliability are more important. Pedals can be catalysts for experiments of sound and circuitry, but they must be sturdy rather than malleable "junk."

environment, be it onstage or in a basement or studio, and "complementing the musical instrument."[222] To create the visuals,[223] Ackermann uses vector graphics in Adobe Illustrator software, which have an angular, geometric look.[224] He then adapts the designs for screenprinting, which requires pressing ink onto a surface through a mesh screen, with a stencil of the design blocking the ink in certain parts. Once screenprinted, the metal enclosures are "clear coated" with a translucent paint to prevent scratching the designs; the painted enclosures must be baked in a specialized oven to dry, while the accompanying screenprinted boxes are merely left out to dry.[225]

Certainly not detracting from these visualizations is the fact that Ackermann created the Total Sonic Annihilation (followed by other pedals) for his own use, and he has emphasized to me that his driving goal is always to create sounds that he cannot find

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[222] These comments are from a follow-up interview in August 2012. "Complementing the musical instrument" is a vague statement, which I take to mean that guitarists with certain stylistic sensibilities similar to A Place to Bury Strangers would view the pedal designs as natural extensions of their chosen instruments and aesthetics—a guitarist in a noise band rather than folk band, for instance.

[223] This process was clarified during an interview in July 2014.

[224] Vector graphics are computer graphics that use simple shapes (called "geographical primitives," such as lines, curves, and polygons) that take up very little data, which means they retain their resolution at high magnification. As result, they are ideal for printing and are popular in graphic design and typesetting. In contrast, raster graphics use a dot matrix structure in a grid of pixels, which can contain more detail and is ideal for photographs but blurs and pixelates as it is magnified.

[225] Ackermann has also recently noted: "We've been getting a lot of work outsourced now for the powder coating and getting parts drilled. When you're drilling out tons of enclosures all the time, the dust starts to add up really quickly, and aluminum dust is not good for you" (Maiolo 2014). I previously worried about fumes and the lack of ventilation in the old workshop (which Conboy tried to rectify with air purifiers), but the new one features high ceilings and enormous windows.

Figure 41. Screenprinting design for the Robot pedal, March 2010
(Photo by Ethan Bowers)

elsewhere.[226] Reviewers commonly cited Ackermann's band, A Place to Bury Strangers, as "the loudest band in New York,"[227] a claim that was alluded to in the band's album *Exploding Head*, which was released around the time I began my research there.[228] In this vein, shortly before the closing of the venue in 2014, Death by Audio notably opened up their loft space for a Halloween 24-hour drone festival; I lasted a few hours enveloped in

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[226] His expression of "finding" or "making" sounds implies that they are hidden somewhere in circuitry, as timbral essences waiting to be discovered, awakened, or coaxed to their full potential. We will see this theme arise throughout this dissertation.

[227] See, for instance, Jim Farber. 2009. "A Place to Bury Strangers is a New York Band That's Loud and Proud." *New York Daily News*. http://www.nydailynews.com/entertainment/music-arts/place-bury-strangers-new-york-band-loud-proud-article-1.411814.

[228] Ackermann has indicated that loudness for loudness's sake is not his goal, although he does not mind if the press wants to claim this. For more on loudness as a form of sonic assault and other aesthetics of independent/underground rock music, see, for example, Bannister 2006; Novak 2013; Reed 2012.

Figure 42. Robot pedal enclosures after screenprinting, February 2010

Figure 43. Packaging ready to be shipped, February 2010

near-darkness and slow, thunderous sound as residents and their friends hauled in a mix of keyboards, guitars, and handmade instruments for improvised, overlapping sets accompanied by A Place to Bury Strangers' lighting and fog machine set-up.[229] The interplay of such raucous imagery and reputation establishes an aura around the material object that leads from sonic capabilities to realities: from Ackermann's (and friends') personal desires to create an aural aesthetic, to its manifestation in the guitar pedal design and construction, to its expansion into written hyperbole and packaging, to the imaginative capacity of customers' that causes them to buy a pedal, and to the physical use of pedals and sonic creation by customers or by members of Death by Audio themselves.

Performing Technology on Film: Technoaesthetics and Music Videos

In addition to the pedal designs themselves and other forms of non- or extra-musical expression (such as the packaging designs seen above), the way musicians self-consciously, selectively represent their work can also be observed visually in music videos. Consider, for example, a video accompanying A Place to Bury Strangers' track "I Know I'll See You." Director Adam Grabarnick filmed the band via webcam while they were stopped on the road in their cramped van. The result is a grainy, lo-fi over-magnification of facial features and hands playing instruments. A series of dull, thin, crooked horizontal lines overlays the screen, pulsing thicker and brighter every few seconds—a sort of watermark that obscures the picture and contributes to a sense of

[229] This event was planned by the venue as a whole and by Mark Kleback, in particular, but served to cement the holistic concept of Death by Audio as a place where such things occur.

jumpy uneasiness in the song. The visual message matches the anxious sonic qualities: droning, otherworldly, fuzzed-out-and-feedback-laden guitars; quick, nervous, treble-heavy drums; an agitated surf-rock vibrato bass line; and urgent, insecure yet deadpan vocals.

The "watermark" lines unmistakably recall the cover of Joy Division's 1979 album *Unknown Pleasures*, the iconic image of which is frequently circulated and analyzed as a landmark of album design.[230] Joy Division is widely recognized as having inspired legions of followers in genres such as post-punk and shoegaze, and as a group influenced by their music—a lineage both obvious to listeners and self-reported by the band[231]—A Place to Bury Strangers would undoubtedly be aware of this image: the white lines of a radio waveform, the pulsar CP 1919, centered starkly on the plain black cover. The cover suggests "the outer-worldly dimension of Joy Division's sound and space and, by proxy, every other emotional/psychic conundrum that has followed in its wake," writes graphic design critic Jon Wozencroft (2007), in a testament to the social life of the image. "CP 1919, this freezing of time over an unimaginable distance, has the most extraordinary afterlife once it enters the mainstream. Recently, it has infiltrated the fashion and art worlds as a signifier of *the beyond*" (ibid.)[232] The CP 1919 waveform

[230] I have not reproduced this album cover here due to copyright concerns, but its image is widely available online.

[231] A Place to Bury Strangers' now-defunct page on myspace.com (a necessary promotional tool for bands until about 2009) once included a long list of musical influences, such as My Bloody Valentine, The Cure, The Jesus and Mary Chain, Joy Division, New Order, and other bands with which they are often compared in album reviews.

[232] Wozencroft, Jon. 2007. "Out of the Blue: Joy Division's 'Unknown Pleasures.'" *Tate Etc.* 10. http://www.tate.org.uk/context-comment/articles/out-blue.

Figure 44. Horizontal lines overlay an extreme close-up of Ackermann. Screenshot from "I Know I'll See You" video (dir. Adam Grabarnick)

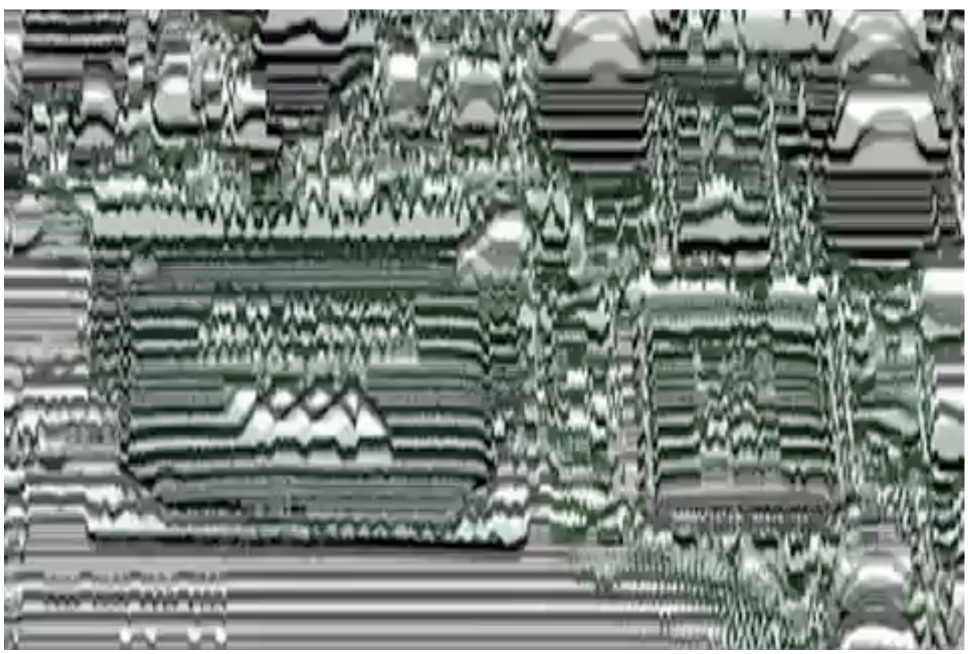

Figure 45. The overlay (on top of integrated circuit chips) becomes more intensely distorted. Screenshot from "I Know I'll See You" video (dir. Adam Grabarnick).

encapsulates the psychological impact of space-age technology, and it projects or "performs" this calm yet unsettling notion of deep space, as mediated through the band's music and artist Peter Saville's design. The technoaesthetics of this image operate here on three levels: the technology of the sonar, its mechanical reproduction as a circulated icon, and its use in A Place to Bury Strangers' music video to "perform" sonic qualities through the representation of iconography.

Meanwhile, other technological images also figure prominently in "I Know I'll See You." Shots of the band are spliced with circuit boards (possibly those of Death by Audio's effects pedals), electrical components, exposed wires, and power lines, which are then juxtaposed with street scenes and the facades of industrial warehouses. The bleak atmosphere of abandoned streets and industrial parks also evokes the physical geography of Death by Audio, then a seemingly uninhabited warehouse situated on an often deserted Brooklyn street. Whether this imagery was the choice of the band or the director remains unclear, but such choices indicate a conscious effort to incorporate science and industry into the overall production of a musical "image" and thus exhibit the "performance" of technology through visual media.

Of the two music videos that accompanied the September 2009 release of A Place to Bury Strangers' album *Exploding Head*, both also featured imagery related to technological mediation. The first video, "In Your Heart," was released that September and highlights shots related to chemistry (via colored dyes), projector screens, and industrial-grade spotlights: the band's image was once again mediated through associations with science and technology. Such imagery applies even more heavily to "Keep Slipping Away," released in December. "Keep Slipping Away" features analog, slightly antiquated items that border on kitsch: old TV sets, spliced images of rotating cog wheels, a hat made from the encasement of a light fixture that resembles the Tin Man from *The Wizard of Oz*, and a green screen backdrop cheekily juxtaposing a floating Ackermann wearing this "hat" against the backdrop of an out-of-focus reality.

Most importantly, this video features Ackermann directly interacting with guitar pedals (Death by Audio pedals, no less)—both presumably building them, by soldering their circuit boards, and fiddling with knobs as a means to manipulate a never-quite-clear video signal. The treatment of guitar pedals as decontexualized objects equates their aesthetic qualities with a more generalized technological image. Shot in Death by Audio's workshop, the video shows multiple pedals lined up and covering the tabletop, resembling a control board rather than fulfilling their actual function of manipulating electrical guitar signals. Thus, these DIY creations transcend their intended use and enter the broader realm of "the technological." In the process, the lines between various machines are blurred, and *looking* like technology becomes a type of aesthetics in its own right.

"Keep Slipping Away" portrays technology as immersive and captivating while also divisive and disruptive. As Ackermann's obsession with the technology grows, the viewer watches his "real-life" relationship with his lover deteriorate.[233] Eventually, he transcends his corporeal self and becomes electrically incorporated into an alternate

[233] Women, although very present at Death by Audio, are largely absent from the technological end. Many women have been involved as tenants, in bands, as a director of one of these music videos, and through other activities, but I do feel that the videos described here portray men as creative loners in domains from which women are shut out. However, my interlocutors invariably try to provide an inclusive environment and are very receptive to such suggestions. In future research, I intend to collaboratively explore gender-based initiatives in DIY music technology.

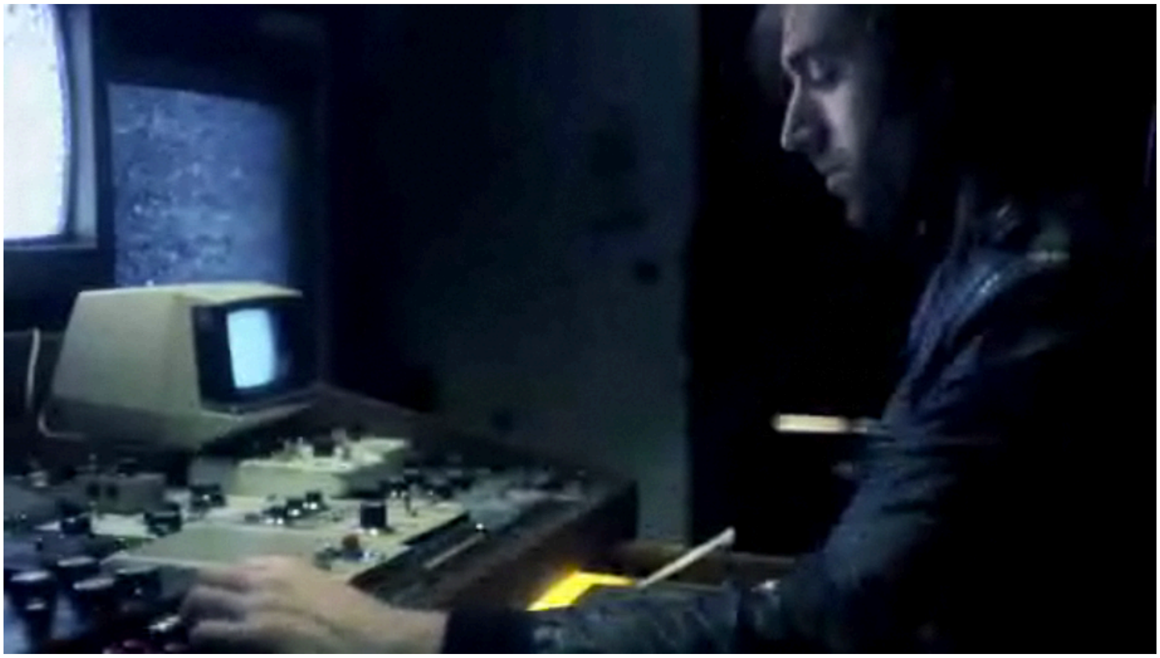

Figure 46. Monitoring and manipulating guitar pedal controls.
Screenshot from "Keep Slipping Away" video. (Dir. Brendan Bellomo and Greg Wilson)

Figure 47. Ackermann enters the virtual realm.
Screenshot from "Keep Slipping Away." (Dir. Brendan Bellomo and Greg Wilson)

reality as part of the television signal. The extension of bodily senses through technology is often theorized as creating a new form of being: the cyborg. As defined by Donna Haraway, a cyborg is "a cybernetic organism, a hybrid of machine and organism, a creature of social reality as well as a creature of fiction" (1991, 149); as a result of this process, the melding of human and machine "conditions our ability to perceive and respond to sensory information" (Helmreich 2007, 622).

Haraway presents this integration of mind-body-tool as a way to break down social boundaries and escape from binaries such as human/machine, physical/non-physical, and organic/industrial; she remains optimistic about the possibilities for technologically restructuring the status quo (1991). This video, in which I would argue that Ackermann is "hacking" technology, offers a way to restructure both the physical circuitry of the machine as well as the output of the sonic (and in this case, visual) environment. Ackermann's transcendence into the virtual world signifies the hybridity and permeability of the cyborg; the cyborg opens up the structure of things, which can be restructured through hacking and circuit bending. Furthermore, Haraway emphasizes the importance of taking pleasure but also responsibility in technology. Ackermann's inability to balance the "real" with the virtual thus offers a parable for the modern cyborg, in which diversion and progress must reach equilibrium.

As of 2015, it has become clear that A Place to Bury Strangers is carrying on the same technoaesthetic. Beyond the identifiable sonic palette, many of their music videos contain similar imagery: music technology, volume, touring, friends and romantic relationships, and Death by Audio itself. Numerous videos have been filmed, partially or in whole, at the venue, and Matt Conboy directed the first video released from the album

Transfixiation, "We've Come So Far," during the band's last set at Death by Audio (more on this night is below). The loudness references that continue to this day include another 2015 video, "What We Don't See," a disorienting whirlwind of thickly textured, clanging, detuned, fuzzed-out guitar tremolo over a steady beat and droning, drowned-out vocals that features extreme close-ups of instruments, gear, and tools (e.g., drum sticks, guitar strings, pedals, pliers, amplifiers) trembling due to sound vibrations, while LEDs flicker and meters flash warnings of "PEAK" and "OVERLOAD."

Lastly, Johnson's band, Grooms, has also figured the pedal workshop into their videos. While the band is perhaps less explicitly tied to Death by Audio's pedals as an aesthetic premise, Johnson does incorporate many of their pedals into designs and has told me that prior to 2015, his whole life revolved around the venue. For "Infinity Caller" (directed by Cora Foxx, with drummer Steven Levine handling the camera, to accompany their 2014 album of the same title), they transformed the workshop into a laboratory, complete with microscopes, petri dishes, and beakers. Seen as a veritable collection of curiosities, other props include skulls, eggs, tree branches, a mortar and pestle, and, most notably, shelves upon shelves of the usual guitar pedal boxes, tools, and electronic components (though far better organized than I had ever seen them in person). Johnson plays the role of scientist, gazing into the microscope at biologically-themed animations that the band gathered from local artists. Merging science and technology with the otherworldly and the ineffable, Cora Foxx explains that the laboratory setting is meant to evoke "an ornate manifestation of mystery, magic and synthesis."[234] As the workshop's

[234] See chapter 2 for more on DIY music technology inspired by biological themes. I thank Cora Foxx for stimulating more of these connections through her comments on the production of "Infinity Caller" (personal communication, August 23, 2015).

materials blend into the background, they help set the scene by *looking* like items a scientist would own.

The song's lethargic, bass-driven groove is overlaid (sparsely, at first, and then drenched) with guitars that range from shrill and ghostly tremolos to swells of volume and reverb to fuzzed-out chord progressions; droning keyboards fill out the texture, and Johnson's artfully strained, desperate-yet-resigned vocals enter, along with ethereal female backing vocals (Emily Ambruso was a longtime bassist/vocalist and former Death by Audio tenant who now occasionally collaborates). What A Place to Bury Strangers and Grooms have in common is, unsurprisingly, an emphasis on noisy guitar tones that alternately provoke and lull the listener. But whereas the former pummels and drowns listeners in waves of sound, the latter has a wider sonic palette that allows Johnson to articulate nuanced guitar lines and that often changes from one song section to the next. In other words, the former's use of effects pedals feels like *total* sonic annihilation, while the latter feels more selectively so. This feeling also comes across in the difference between the videos: Ackermann's storyline has him so consumed with having all the technology at once that he *becomes* it; Johnson selectively meanders his way through a scientific experiment as a carefully arranged selection of pedal boxes surrounds him. As I stated above, however: *the treatment of guitar pedals as decontexualized objects equates their aesthetic qualities with a more generalized technological image* (which, in the latter, might as well be laboratory equipment). In these examples, the objects that these two guitarists build become part of not only the sounds they play but also the settings in which they think, create, and perform, forming an ecology of sonic objects from which it is not so easy to extract themselves.

Figure 48. Screenshot from Grooms' "Infinity Caller." Note the Weller soldering iron and spools of solder and/or wire hanging in the background. (Dir. Cora Foxx)

Figure 49. Screenshot from Grooms' "Infinity Caller," surrounded by shelves of guitar pedal components. (Dir. Cora Foxx)

Intersections with the Maker Movement and the Art World

The arrival of a new tenant in mid-2009 expanded the scope of DIY music technology at Death by Audio. Mark Kleback finished an electrical engineering degree at Penn State and had moved to New York on a whim earlier that year. Coincidentally, I knew Kleback as a drummer, in what felt like a former life of touring in bands around the Philadelphia region and being paired together on many bills. We had lost touch, and I was pleasantly surprised to hear that he had undertaken the very kinds of activities I had begun writing about. While living in a shared Bushwick basement, he began experimenting with the Arduino (he was not yet acquainted with the Maker movement, but was excited by the possibilities of such an inexpensive microcontroller); then, once his roommates decided that New York had outpriced them, he had a chance encounter with Death by Audio. He recalls, "I met one of the guys from Death by Audio at a bar, and I started telling him, 'I'm working, I'm a musician, I like building circuits, and I just want a place to live.' And he's like, 'Well, I live in this loft where people make guitar pedals, and there are musicians. If you can handle people staying up all night blasting music, you might want to check it out.'"[235] Kleback suddenly found himself with a room and an instant community of likeminded people.

He was a natural fit at Death by Audio whose tenure in the space lasted until the very end, and he added a practical dimension and a wider vision to the guitar-centric atmosphere. After dividing his time between working at an electric bicycle shop on the Upper East Side and tinkering with musical projects, Kleback heard about a graduate program in Interactive Telecommunications (ITP) at New York University. As previously

[235] Quoted comments are from an interview in February 2015; all other information is from five years of informal conversations.

mentioned, this program has produced at least a handful of DIY music technologists; most graduates identify as "creative technologists," meaning that they are artistically-minded, familiar with a wide range of analog and digital technologies (e.g., Arduino, coding, electronics, laser cutting, 3D printing), and able to construct rapid prototypes for projects. Citing a phase of creeping aimlessness ("Death by Audio was really inspiring, but I worked at this bike shop all day"), he prepared a portfolio of his music technology projects and was soon accepted. Meanwhile, Kleback started a noise project with other tenants and friends called Fuck Ton, for which he also learned Max/MSP software to produce accompanying visual projections. "I think maybe around 2010, I reached a point musically where I didn't want to play drums in a rock band anymore. I wanted to be *really* experimental. [….] It reached a point that was…ridiculous. But I started getting really focused on what the feeling would be, rather than was I was playing. It didn't matter what I was playing, anyway. I just wanted a sensory overload." Overall, this convergence of the two scenes helped Kleback find a community and sense of purpose in Death by Audio and ITP.

Kleback's influence put Death by Audio in conversation with the Maker Movement. ITP existed long before "making" took off as a cultural phenomenon, but the skills it emphasizes are directly applicable to Maker projects. He joined me at Bent Festival and for events at skill-building spaces like NYC Resistor. Throughout 2010-2014, I encountered him building a number of experimental instruments at the site, such as a programmable Arduino-based synthesizer and a bass drum that triggered strings of rope lights with each kick. In another instance, inspired by one of Ackermann's designs that employed a digital reverb chip, he tried to build a reverb pedal of his own. To do so, he found a schematic on a website called DIY Stompboxes, which was itself a modified version of another schematic, then used one of Death by Audio's extra chips to modify his own variation. Although the pedal worked, he was not satisfied with the results, calling the sound too "straightforward" and hoping to experiment further to "modify it into something a bit more edgy."[236] None of these experiments moved beyond the prototype phase, but each project allowed him to test and enhance his growing skillset.

Meanwhile, Kleback brought other creative technologists and artists working with new media to Death by Audio for parties and to collaborate on projects, and he introduced Death by Audio's work to other types of arts scenes. In August 2014, for example, he exhibited two projects at the lwlvl ("low-level") Festival for "retro-futuristic music and visual art,"[237] held just a few blocks from Death by Audio. The first was his Marimba[238] Automaton, powered by the automated turning of motor-controlled wooden gears. To construct the instrument, he drew on skills he picked up from a number of previous projects and solicited help and advice from an infrastructure he cultivated through a few years' worth connections made through ITP and Death by Audio. In his online documentation he wrote, "I was inspired to build this after thinking about how rhythms could be thought of in circular patterns, and how different size circles could

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236 Kleback's blog, Kleebtronics, documents many of his exploits: http://blog. kleebtronics.com/digital-reverb-pedal

237 Under this heading, the festival also represented the "chip-music community," as well as glitch art, and thus featured participants like Daniel Temkin ("Notendo") and Rosa Menkmen (see chapter 3). Chip music, also known as chiptune or 8-bit music, employs old sound chips embedded in video games consoles and computers.

238 There are no keys, however; metal tubes are struck directly. In a marimba, wooden keys are typically struck, which have resonators below. It is certainly a metallophone, in any case.

produce loops of varying lengths." The idea began as a Max/MSP patch to help students learn about polyrhythms in an afterschool class he co-taught at a Brooklyn high school, but he soon figured he could use motors to make physical circles turn. This worked as follows:[239]

> *__Twelve gears of varying sizes__ were cut from plywood and mounted on a wooden platform.
> *A **motor attached to a pulley** drove the largest gear at certain rate of beats per minute.
> *The **teeth of the largest gear interlocked** with and turned the smaller gears.
> *A **nail** attached to each gear would **hit a switch** each time it made a rotation.
> *Each **switch sent a voltage through a guitar cable to a solenoid** on the other end. Solenoids are components that push or pull, in this case pushing outwards to strike a marimba resonator (pipe/tube) each time a pulse was sent from the switch.
> *__Aluminum pipes__ were cut from scrap metal into varying lengths. Each length was supposed to represent a certain desired **frequency** for a pipe, so that when lined up in order, the pipes would **play a scale**. (Although he had an equation for determining the lengths, in practice this involved enormous trial and error, with the help of a guitar tuner to test the notes in the scale.)
> *The **pipes were mounted at their nodes** (the places they vibrated least, also determined by an equation).
> *The **solenoids** were mounted so that they could **strike the pipes** at their centers. (Marimbas are typically struck on wooden or synthetic bars above the resonators rather than on the resonator pipes themselves.)
> *Once turned on, the gears' interlocking **polyrhythms** caused the notes to be struck at varying intervals.

The numerous steps required to carry out this project were possible only because of an infrastructure of materials and assistance. Kleback did most of the construction at Death by Audio (which also provided an the power switch and guitar cables), but he relied on some teaching acquaintances for advice and for scrap materials from their art studios. A design and fabrication studio in Greenpoint helped make the gears, and an ITP colleague who incorporates gears into his own sculptures advised how to mount and power them. The popular electronics supply website Sparkplug supplied electronic

[239] Documentation is available at: http://www.kleebtronics.com/marimbaautomaton.

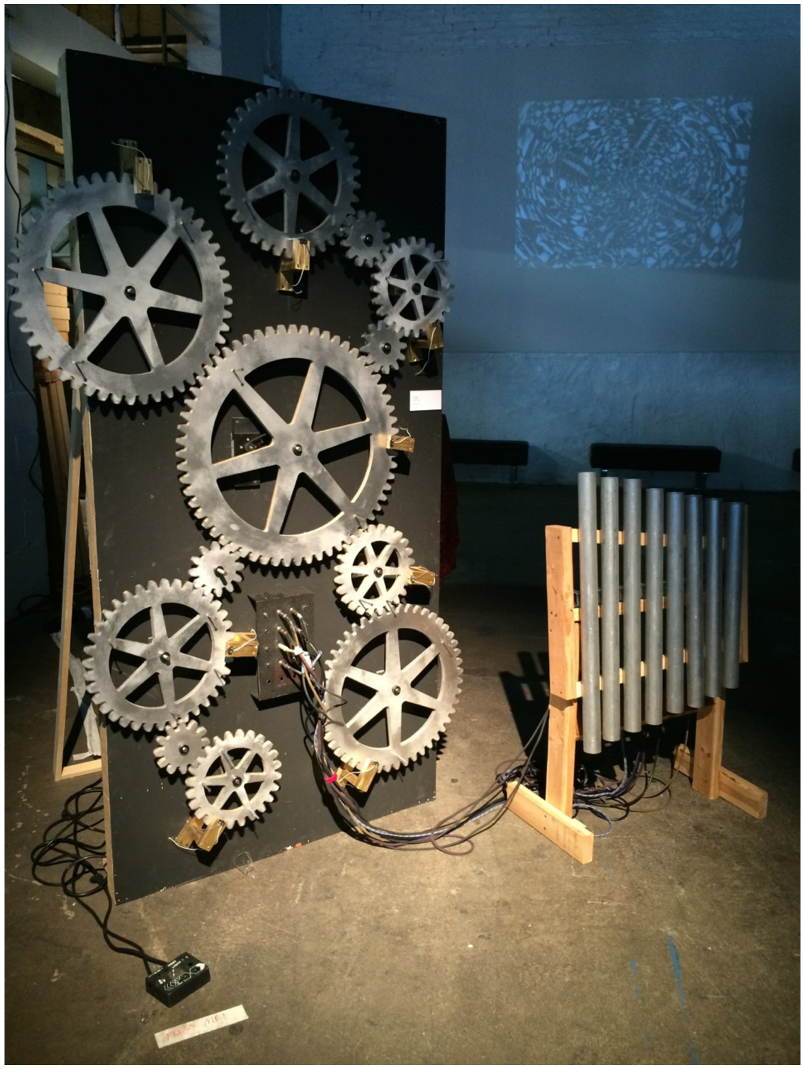

Figure 50. Mark Kleback's Marimba Automaton, lwlvl Festival, August 2014

components and technical specifications. The how-to website Instructables provided mathematical equations for building a marimba. The warehouse run by a production company called Villain rented out their space for the festival. The lwlvl Festival commissioned the instrument (or is it a sound sculpture?), and once this door opened, it allowed Kleback to suggest featuring Death by Audio's indie arcade cabinets, as well. Finally, exhibiting his work alongside local artists such as Phillip Stearns (see chapter 3 for more on Stearns) put him in touch with networks of new DIY music technologists.

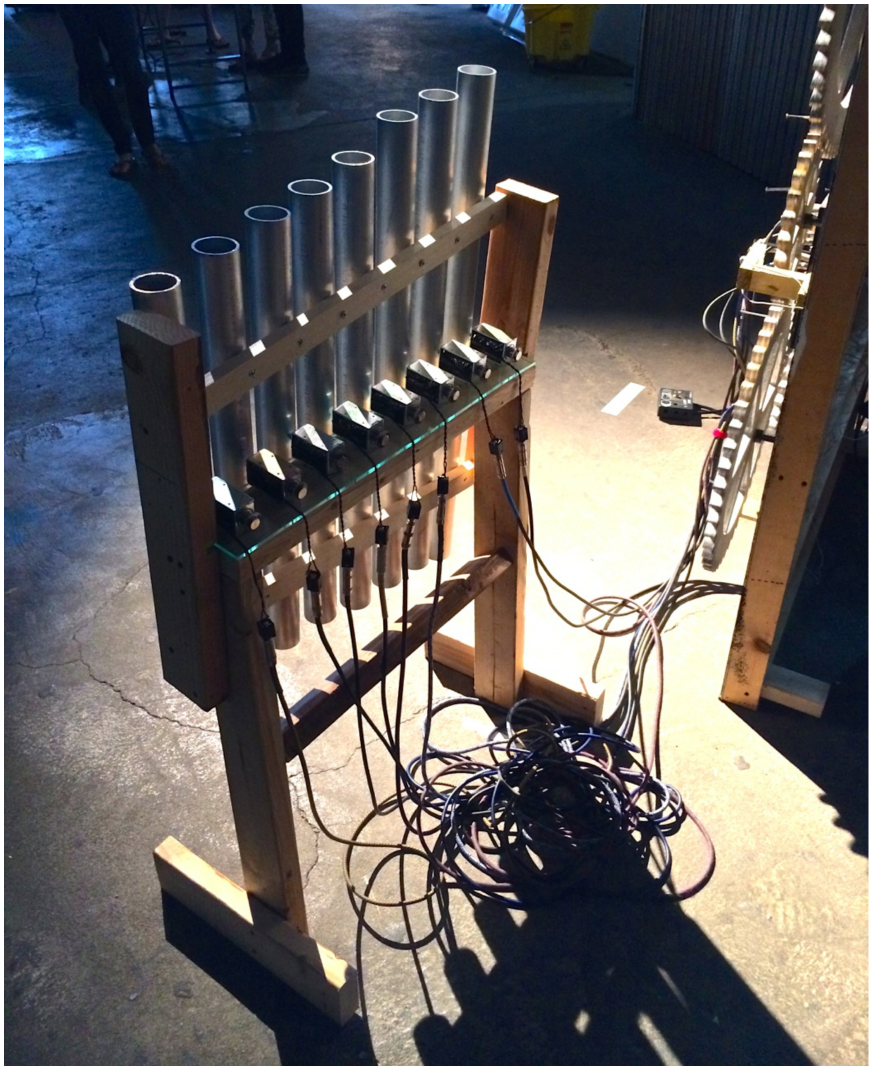

Figure 51. Solenoids poised to strike the marimba's pipes

The second project at the festival was a culmination of a few years' worth of collective effort, the Death by Audio Arcade, of which Kleback is the curator. Although not explicitly musical (though certainly arcade-sound-effects-producing), this project has embedded itself into a network of scenes surrounding DIY technology. First, Kleback developed this idea in part after interactions with Kunal Gupta, a member of live-soldering Bent Festival favorites The Loud Objects and indie video game pioneers Babycastles. Second, Death by Audio has exhibited the arcade a number of times within its own walls, for its "Deathmatch by Audio" parties. Third, the arcade was accepted into the 2014 Maker Faire, where I found Kleback working to explain the process to interested Makers and game developers, adults and children alike. Fourth, the arcade was featured a 2014 Indie Games exhibit at the Smithsonian American Art Museum; this, in conjunction with opportunities in a growing push for galleries that allow video game developers to display their work, demonstrates a shift towards Kleback conceptualizing his projects as "art" to be disseminated for viewers beyond the DIY scene.

Today, Kleback teaches classes in creative technology as an adjunct lecturer and in local high school afterschool programs and art centers. But moreover, he is working to establish a design studio with other ITP alumni with whom he previously collaborated when they were individually contracted by a large company with an advertising campaign that involved refashioning antiques to interface with the digital age and putting them on a train. They combined efforts to launch the studio in order to have more control over available projects, on which a studio bids. I asked him if this type of work equates to the technology start-up world, but he explained:

> I hesitate to say "start-up" because *start-up, to me, feels like you have this idea that's a moneymaker, and you want to get rich quick*…whereas for [his studio collective], we're like, "We have these skills, we can do these things, you should hire us because we are skilled in x, y, and z. And yes, we can work for advertising agencies, and some projects might be cool and some projects might suck, but I think what we're going for are big public art installations that are commissioned, so that it's not so much someone breathing down your neck being like, "Can you slap a logo on this? That's not a big deal, right?" Digital agencies seem like a drag because of that—but, I mean, the projects we did were pretty cool, so I'm not knocking it entirely. [In comparison, he mentions another studio's clients, which he felt had very exploitative goals.] *I don't want to be a part of that world*. That world seems terrible. (Interview, Feb. 2015; emphasis mine)

What, then, of the Maker Movement? Although he is ensconced in it himself, Kleback replies that he does not view aligning himself *too closely* with it as a viable long-term option:

> It involves an air of…this is not a professional thing, this is a hobby (as with *Make* magazine…). I've gotten a lot of jobs as a "Maker educator," where I go in and teach Arduino or Raspberry Pi to a group of high school kids. I feel like people are like, "Oh my god, there's so much possibility with 3D printers and laser cutters and all this technology, and *we have no idea what's going on*—but these Makers, *they* know what they're doing." But you can't bill yourself as a Makerspace, because then it's like, "Oh, they just make little trinket-y, 3D printed stuff, and it's not serious." So, [we're] trying to give that a little bit more professionalism. We're a creative technology studio, I have an EE [electrical engineering] degree, people have worked for very prestigious organizations…it's trying to be a little more than that. (ibid.)

In my chapter on the Maker movement, we saw tensions displayed between hobbyism and professionalism that in some ways mirror the underground music scene's tensions between DIY and "corporate." Kleback's take on the movement demonstrates his position at the juncture of all of these perspectives: he views Makers as lacking in "professionalism," yet, as seen above, he views technology start-ups as too invested in money alone. I believe that Kleback's underground music background shapes his outlook in that he values the DIY ethos yet distrusts its ability to translate ethos into survival. Kleback is open to collaborating with the venue's other participants again, but I suspect that the fragmentation of Death by Audio's community and his need to launch himself beyond their eulogized reputation will override any such immediate plans.[240] In this next

[240] His arcade is retaining the Death by Audio name "as an homage," and he hopes to find it a new home in a gallery with non-profit status. Although interested in planning future events, he is pessimistic about finding a new dedicated performance venue due to logistical concerns, commenting, "The rent inflation is so ludicrous that I don't even know what neighborhood to go to." Citing the Silent Barn DIY venue (mentioned below),

section, I explore how Death by Audio, as the stalwarts of Williamsburg DIY, splintered in the wake of pressures that thwarted creative and financial longevity.

Five Years On: Death of a Venue, (After)life of a Business

When I revisited Death by Audio in July 2014, I was surprised to see how much remained the same. Despite my prediction that the pedal business, if not the entire venue, would struggle to grow while retaining its DIY identity (akin to many Maker movement endeavors discussed in later chapters), I found that this was not the case. Pedals were selling at a feasible rate, the show space was as active as ever, A Place to Bury Strangers continued to tour and release albums,[241] and the loft space housed the ever-changing set of new residents in addition to Ackermann, Conboy, and Kleback. They even seemed isolated from the much-hyped gentrification of Williamsburg, an artists' grungy utopian island in an expanding sea of luxury condos and upscale restaurants.

When I sat down with Johnson and Ackermann, who were at work fulfilling pedal orders, to discuss what "DIY" means to them, I learned how they resolved the tensions between being a business and an emblem of the underground music scene. Sales had certainly increased due to media publicity surrounding A Place to Bury Strangers and other bands who used the pedals. However, this increase transitioned into an opportunity

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he says a new venue would only be worthwhile if it could be "more permanent," less liable for real estate develops to force a swift exit.

[241] Album reviewers now often seem dually bored and fascinated with the band's consistency. One states that a 2015 album, *Transfixiation,* "…never distracts from intimating the same old points: Ackermann makes expensive guitar pedals and the band plays with a ferocity that will make theirs the only show you'll want to see for the next month—and due to its ear-splitting volume, maybe the *only* show you'll physically be able to hear for a month." Review by Ian Cohen (2015) for *Pitchfork Media*. http://pitchfork.com/reviews/albums/20096-transfixiation.

Figure 52. Exterior of Death by Audio, view down S. 2nd St. towards the East River, July 2014

Figure 53. Oliver Ackermann and Travis Johnson in the workshop, July 2014

to turn supplemental income into a career and to provide local musicians with flexible part-time work. Ackermann and Conboy just work *harder*, Johnson joined full-time (as mentioned earlier), and friends-of-friends are called in as needed.

But there were also hiccups, and attempts to anticipate and prepare for any kind of growth trajectory proved elusive. After the initial bump, Ackermann was surprised that sales kept growing, given that he thought his designs would only intrigue a certain kind of adventurous, noise-oriented guitarist: “You would think everyone who wants this kind of thing would have bought it by now!” Then he would be proven right, as business seemed to sporadically dry up (“I'd check my email and think, ‘Well, this is it!’”) and then wrong yet again. Once, both Ackermann and Johnson were both away touring with their bands, leaving Conboy to handle the business alone, when sales reached another uptick. When they called to check how things were going, he hesitated, “It's going well…. [*reluctant pause*] I had to hire someone new.” From then on, the team knew they would have to expand production somewhat to allow them to maintain lives outside of Death by Audio. As of that summer, the work seemed to have stabilized, though an air of uncertainty hovered. A few part-time workers quietly wandered in during my visit, and joking around but also working diligently, while Johnson punctuated his thoughts by soldering; he used to have days pass by without much work to be done, but no longer. Johnson does not experiment with electronics at home, since he spends so much time with electronics at Death by Audio. “I don't have a soldering iron at home.... I don't even have an amp,” he told me; since his band also rehearsed there, all of his equipment was at the venue.

Since they are now both veterans of the local underground music scene, I asked if their musical tastes had changed, thus affecting the pedals they built. Although both have used Death by Audio pedals in their own music, there was some debate about "maturity" and the appropriate selection of sounds effects as one ages (both are now in their thirties). "It has to match the aesthetic," said Ackermann. "I'm not going to use the Robot [low-fi, 8-bit, pitch transposer pedal] or something. That wouldn't make sense." Nevertheless, his driving aesthetic is still "rock and roll...dark, depressing, evil, noisy." Johnson used to incorporate the Octave Clang pedal, when his band was bent on being noisier, but now his focus has shifted to more melodic compositions that require other timbres.[242]

Despite these transitions, the DIY ethos is still intrinsic to their identities. At first, they seem amused that I would even question such a thing, but they soon open up. Ackermann began hesitantly, "I think it's about wanting to run a good company, but doing it...ourselves." To him, DIY means not answering to corporate interests beyond himself and his peers, and it is important to him to be able to provide his friends with employment. (Local independent musicians with touring obligations typically face difficulties finding and keeping work; they are typically relegated to food service or temp agency work, but even this dried up during the recession. Ackermann is thrilled that he can help the music community by providing some extra income, however modest.) What separates them from the bigger companies is being able to be more adventurous, more

[242] Conboy was previously in the bands Sisters and the Immaculates but is not actively performing. Johnson's band Grooms previously referred to themselves as a "noise pop band" but appear to no longer list this designation. Multiple residents and friends of Death by Audio also collaborated on the noise group Fuck Ton, which was most active in 2011.

flexible, and not worrying about impressing stockholders or other trappings of corporate culture.

I ask if they see "DIY" as a line that can be crossed. They pause to reflect. Does this occur "when someone has investors and corporate partners they have to answer to"? "We can take risks that big companies like Boss can't," such as not worrying about FCC regulations or designing a pedal based on an abstract idea like "insanity." How have must one go to be DIY in the first place? "We already outsource our PCBs. Maybe that's less DIY?" suggests Johnson. "Some things you just can't get here, like the metal enclosures," says Oliver. (Surprisingly, he notes that this is due to more relaxed safety regulations in the U.S., making the American-made enclosures more dangerous.) Johnson wonders aloud whether the materials bought in other countries might be produced through sweatshop labor, and they pause to consider the implications of that. As a reference point, though, they bring up DIY icon Ian MacKaye, of the bands Fugazi and Minor Threat, and tried to recall how much he supposedly did himself (or with the help of close friends) while recording and touring.[243] Travis concluded that in MacKaye's case, "It doesn't make sense to make your own jewel cases. You've got to stop somewhere." Meanwhile, DIY also means being in charge of keeping their promises to uphold quality, even if it comes at the opportunity cost of completing new work. They still offer a lifetime repair

[243] Questions of outsourcing and what constitutes "handmade" have been more problematic for Etsy, the online marketplace for DIY goods, contributing to significant growing pains for the Brooklyn-based business as it transitions into a vastly profitable enterprise: "For many of its fans, Etsy is much more than a marketplace. They view it as an antidote to global mass production and consumption, and a stand against corporate branding. It's their vote for authenticity and good old craftsmanship, and a seemingly ethical alternative to buying from big corporations. And it has helped spur a wider industry of items that claim to be artisanal, authentic or bespoke, whether bedsheets or beef jerky" (Tabuchi 2015).

guarantee for any reason. They say about half the pedals are not even broken—"just that someone's battery died, a cable broke, or a knob fell off'—but they investigate all requests. I watched Johnson troubleshoot a pedal: desoldering, testing it through a small amplifier, and double-checking with Ackermann.

Despite their own commitments to the local music scene and running an ethical business, Death by Audio was afraid that the neighborhood might force other transitions on them. The topic of gentrification haunted our talks, so I asked how much longer they expected to stay in the building, given the astronomical rent increases in Williamsburg. "I don't think we'll be here much longer. Not since Vice is moving in…." Ackermann trailed off, referring to how the Vice Media company, with its corporate-journalism-meets-über-hip aesthetic, had just bought the building next door. He feared they might eventually take over the block, but concluded they were safe for the time being. Where would Death by Audio relocate, given the choice (or the shove)? "I honestly don't know," said Johnson, noting that rent prices in Bushwick (situated a few more subway stops into Brooklyn) were already matching those in Williamsburg. Ackermann's favorite burger joint, which resided on the corner for many years, just shut down. "Edan [Wilber, a friend in charge of booking the venue's performances] won't charge more than $7 or $8 for shows," says Johnson, in order to maintain an inclusive, all-ages atmosphere. A substantial rent increase would not be feasible. I left knowing that the possibility Death by Audio would be priced out of the area loomed as *not if, but when*.

Barely a month later, signs began to appear. First through cryptic Facebook posts, then gossip on local music blogs, and finally through a statement on the venue's website, the hushed word got out that the end was even nearer than I had imagined. The landlord decided not to renew Death by Audio's lease in November, instead handing over the rights to none other than Vice Media. In what came as more of surprise, the venue did not know the lease was ending. Believing to have signed a two-year contract ending the following June, they scrambled to find their copy—only to find they had misplaced it. The landlord, with whom they had long maintained a good relationship, produced a copy of a lease lasting one year and five months. The odd length seemed too convenient, but they had no grounds for argument. (Rumors also swirled that Death by Audio was "bought out." This is only somewhat true, as they had their last few months' of rent waived in exchange for peacefully vacating the premises as requested but did not have an alternative to stay.)[244] It stung that Vice, in particular, was displacing them; the website and its music blog, *Noisey*, had previously featured A Place to Bury Strangers and Grooms, as well as interviews with the pedal business. The irony of a company that had grown enormously far from its own DIY origins (as a magazine in Montreal) to selling itself as a multi-billion-dollar brand of "edgy Brooklyn cool" now driving the last DIY venue out of Williamsburg was lost on no one.

The move also made waves in the real estate world. Early on, *The Commercial Observer* documented the mechanics behind the deal:

> Mr. Conner [the real estate broker] had recently worked with Sol and Leo Markowitz, owners of two connected buildings at 49 South 2nd Street, once the original headquarters for Domino Sugar, and 285 Kent Avenue [which briefly housed the eponymous DIY venue 285 Kent]. The Markowitz brothers initially purchased the buildings, which collectively

[244] This debate turned into something of soap opera in the coming months. The story began with statements made on behalf of Death by Audio and led to a saga of fact-checking and snark: http://bedfordandbowery.com/2014/12/death-by-audios-edan-wilber-on-what-happened-with-vice-and-whats-next; http://www.brooklynvegan.com/archives/2014/12/death_by_audio_11.html; http://www.nytimes.com/2015/02/24/arts/music/vice-media-vs-brooklyn-indie-music-clubs.html

> total 75,000 square feet, 15 years ago as a home for their electronic accessory business CTA Digital.
>
> Mr. Conner believed the space at these addresses was not fulfilling its post-gentrification potential, especially given the scarcity of commercial space available in the area. When presented with the option, developers working in Williamsburg almost always choose to convert buildings to residential units. “If I build condos in Williamsburg, I will sell them,” Mr. Conner explained. “If I build an office building, I might be stuck with it.” Moreover, in the 15 years since the Markowitzes made their purchase, Williamsburg had changed drastically. “There were empty buildings. It wasn’t a safe neighborhood,” Sol Markowitz said of his early days in the area. Today, the neighborhood commands $60 per square foot for commercial space.
>
> Though the brothers had tenants that embodied the area’s creative bent, including popular music venue Death By Audio, Genius Media, Windmill Studios, indieScreen and Brooklyn Bowl, Mr. Conner envisioned the sizable space meeting Vice’s specific and difficult-to-achieve needs. All it would take was the Markowitz brothers agreeing to simultaneously terminate the existing leases, empty the properties and create a full space the right size for Vice. (Schlanger 2014; paragraphs condensed)[245]

Anticipating that a move was inevitable, whether due to Vice’s expansion now or perhaps a luxury developer later, Death by Audio’s residents and partners decided to go out on a positive note. For a while, no one explicitly commented on Vice’s role in the matter; instead, they embarked on an ambitious plan to host a mix of concerts and events every night until their departure on November 23, 2014. In the interim, they became the rallying cry of the music blogosphere; even the *New York Times* ran a piece on “The Last Rites for Death by Audio” (Ryzik 2014), an unthinkably high-profile mention for a DIY venue.[246]

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[245] Schlanger, Daneille. 2014. “Vice’s Grip on Williamsburg Reflects Changes in Gentrifying Neighborhood.” *The Commerical Observer*. http://commercialobserver.com/2014/09/vices-grip-on-williamsburg-reflects-changes-in-gentrifying-neighborhood.

[246] A follow-up article in the same publication later asserts a Vice vs. DIY rivalry more forcefully. See Moynihan, Colin. 2015. “Vice Media vs. Brooklyn Indie Music Clubs.”

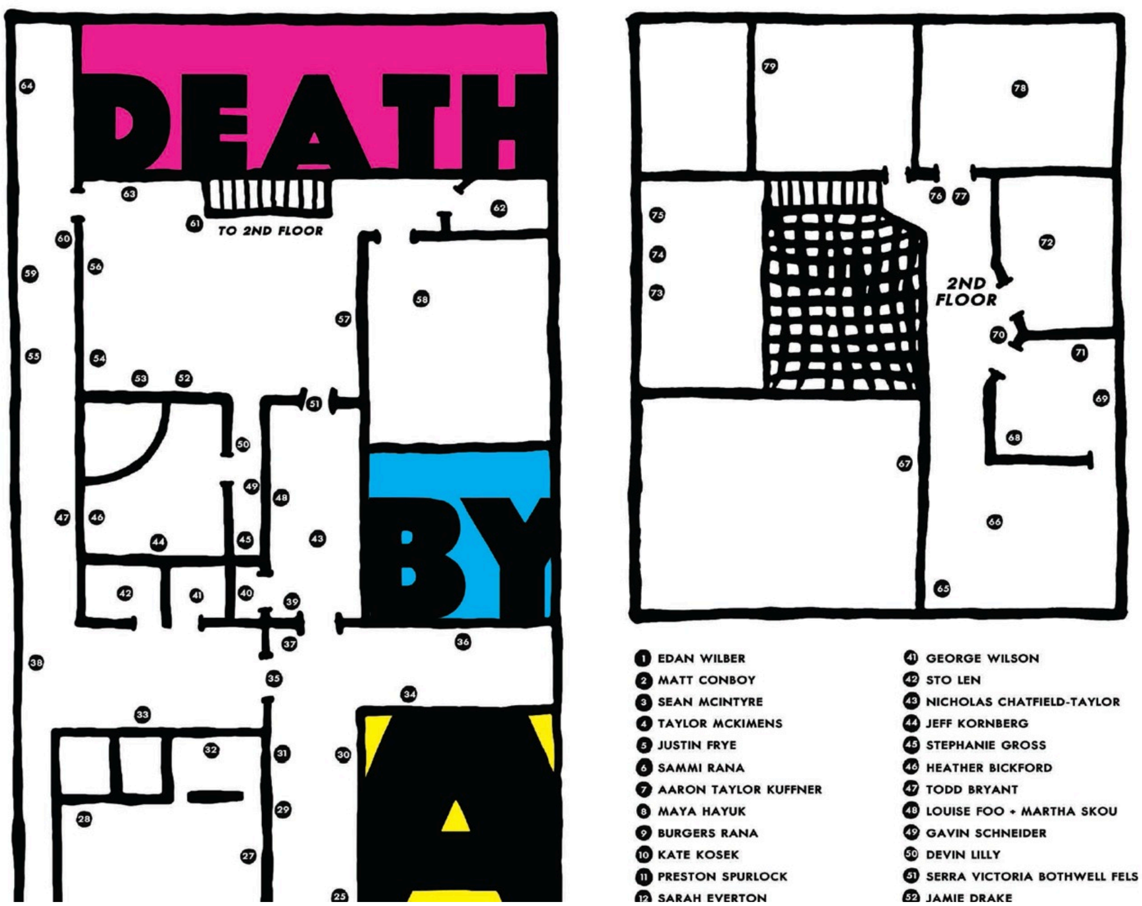
The schedule included the aforementioned 24-hour drone festival, performances every night of the week, and the Death by Art exhibit. The latter was open to audience members each night and featured an opening event in which visitors could wander freely through most of the building. Participants included residents, friends, local musicians, members of other New York DIY spaces, and Kleback's connections who work with creative electronics. Photos, murals, and installations covered nearly every inch of space, some abstract and others commenting on the artists' experiences with Death by Audio. Themes of punk rock and new media intertwined, with highlights spanning the indie arcade consoles, the "RIP DIY" photography gallery from concerts spanning the life of the venue, experimental sound cabinets, and a robotic gamelan sculpture.[247]

In one sense, the already porous boundaries were breaking down between Death by Audio and the community and between all the various functions within the venue (as home, as business, as concert hall). Meanwhile, these boundaries were also physically breaking down. Construction foreshadowing Vice's move started early and often, as the rooms above were remodeled, jackhammers grinded, walls crumbled, and mishaps like flooding impeded the normal routine.

The New York Times, Feb. 24. See http://www.nytimes.com/2015/02/24/arts/music/vice-media-vs-brooklyn-indie-music-clubs.html.

[247] The latter might be of interest to ethnomusicologists, although its inventors do not seem to be part of Death by Audio's inner circle. The "gamelatron" is a "kinetic sculpture" by Aaron Taylor Kuffner and Eric Singer that automates traditional gamelan instruments; multiple exist and have been featured in exhibitions internationally.

Figure 54. "RIP DIY" photography in the corridor of Death by Audio



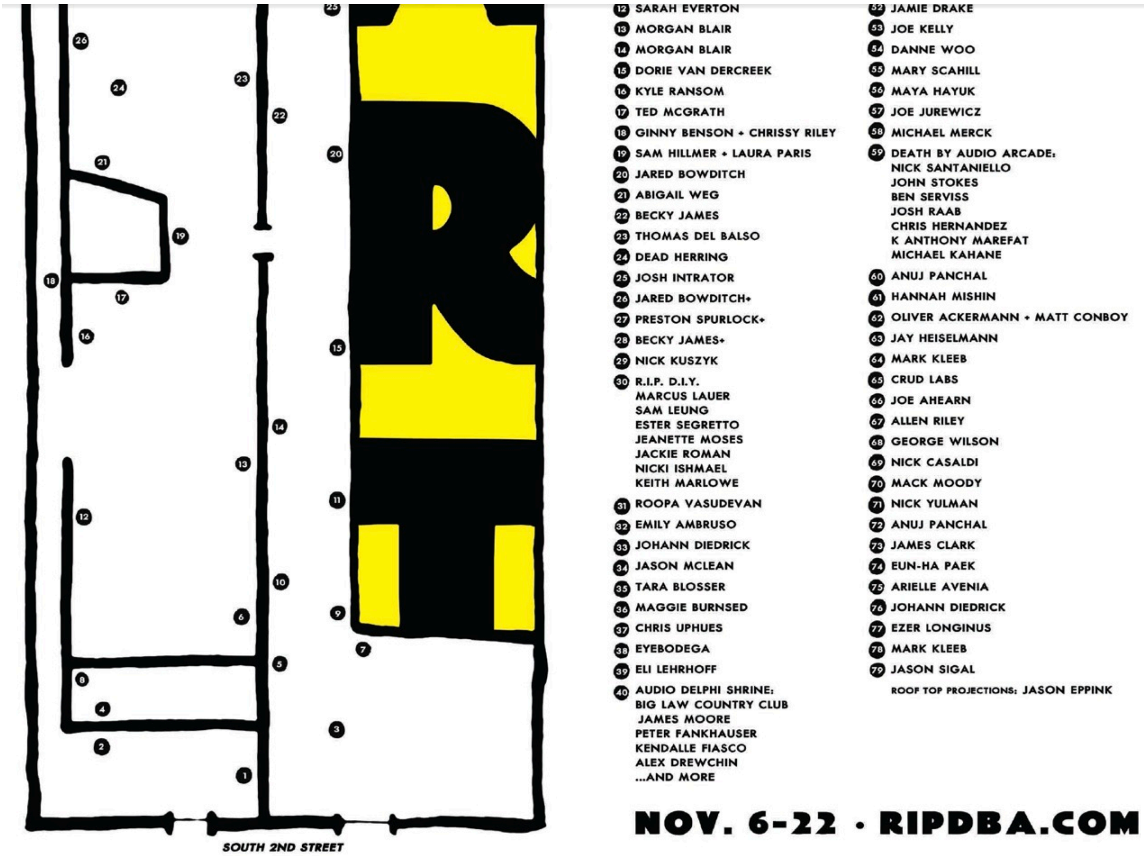


Figure 55. Sketch of Death by Audio, created for the 2014 Death by Art exhibit[248]

On November 22, the final night, the line snaked around the block hours before a secret roster of bands took the stage. Hundreds of people waited in hopes of sharing a farewell party in a beloved venue, as volunteers served hot chocolate to help pass the time in the cold. Only a small fraction of the crowd could fit inside, and I was fortune to be among them. As expected, the "secret" bands included Grooms and A Place to Bury

[248] Maps were also handed out in person upon arrival, but this digital version is from ripdba.com. The colored-in parts were off-limits, including some of the tenants' rooms and, at top ("Death"), the guitar pedal workshop. Other notable features: the two entrances on South 2nd Street lead to a long corridor (at right) and the performance venue (at left); the thin walkway at far left was only open due to construction; the main bi-level living space (at top) includes the living room/kitchen, apartments, bathrooms, rehearsal space, recording booth, workshop, and the infamous industrial-strength cargo net (hung from the ceiling for lounging in).

Figure 56. The line stretched around the block for Death by Audio's last night.

Strangers, along with indie stalwarts Lightning Bolt and Jeff: The Brotherhood. By the third set, Ackermann took the stage in front of a sweltering sea of beleaguered ears and bodies too long on their feet but willing to brave the noise. As is typical at his live shows, a wall of fuzzed-soaked, dreamy-yet-aggressive guitar timbres and muffled, deadpan hints-of-vocals seeped through a disorienting blur of fog, strobes, and lasers (that somehow comes across more as moody indie rock rather than as a tacky *Spinal Tap*-esque gesture). Surrounded by a raging crowd on all sides, including crowd-surfers above, while pummeled by sound, listeners were overstimulated to the point of desensitization. Afterwards, under the harsh fluorescent hallway lights, ears rang, beer cans piled, and nostalgia brewed. My stamina began to give way. And this was all before the intensely experimental noise-rock duo Lightning Bolt had even begun.[249] Although I was too exhausted for the afterparty, widely circulated photographs illustrated that the night was capped with the systematic destruction of Death by Audio residents' former collections of *Vice* magazines.

The next day, Death by Audio moved out. The DIY venue, with its many facets and functions, was over as I knew it. Tenants relocated to the apartments of friends and significant others, some took long-awaited vacations, some left the city altogether. Although the stance towards Vice Media had turned ugly, this DIY community accepted its own impermanence. Despite the official-sounding status of an LLC housed in a non-profit venue, Death by Audio never quite felt legitimate—its existence always a bit precarious, a bit unfinished—perhaps by design (and by lack of a dependable lease), but also likely due to the fly-by-night expectation for DIY spaces.[250] "DIY groups curate independent art installations and serve alcohol, sometimes without the required paperwork. And many of them have a casual regard for the distinction between

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[249] This latter type of noise band takes its cue more from the groups outlined in David Novak's *Japanoise* (2013), whereas A Place to Bury Strangers retains more of a traditional rock band feel, channeling 1980s-1990s bands like the Cure and Jesus and Mary Chain.

[250] As another displaced tenant, Ric Leichtung from 285 Kent, told the website *Gawker*, "The landlord's been waiting for a pay day like this for years. The landlord's made little headway on bringing the building up to code to host legitimate businesses, opting for these really short term 2 or 3-year commercial leases to illegal loft spaces and quasi-legal establishments like 285 Kent so that the landlord could easily kick them out or wait for their leases to expire and cash in when they found a buyer. Current tenants are still discreet because they're still under that landlord's roof, but really the writing's been on the wall for a while." Although *Gawker* is a gossip site, its article "No One Wants to Say It, but Vice is Displacing Brooklyn Institutions" was circulated widely among the DIY music scene and appeared in numerous posts on Facebook. See http://gawker.com/no-one-wants-to-say-it-but-vice-is-displacing-brooklyn-1649005022.

residential and commercial space. There's no guarantee how long a place like this might stay open," writes *Village Voice* correspondent Jessica Goodman (2013).[251] In the past few years, however, other peer venues that were previously shut down have reemerged, determined to establish something more permanent. Silent Barn and Market Hotel have made headlines for "attempting to negotiate an uneasy truce between legal good standing with various city bureaucracies and a community that's drawn to the DIY subculture for its unrefined, egalitarian ethos, which is in some ways antithetical to the byzantine process through which ideals become businesses (Pantuso 2013)."[252] Death by Audio has no immediate plans to reform, mostly due to their uncertainty about finding an arts-centric yet affordable neighborhood, but whether they follow suit remains to be seen.

Music Technology in the New Manufacturing

Interestingly, the pedal business itself—the main livelihood of some of these musicians—lives on, having relocated down the street from the Brooklyn Navy Yard, a sprawling industrial complex that that spans the East River waterfront from the south side of Williamsburg across the Clinton Hill, Fort Greene, and DUMBO/Vinegar Hill neighborhoods. Guitar pedals in the shadow of a former military base might seem an odd pairing, but according to a Pratt Institute report, the yard "has been transformed from a naval shipyard to a modern industrial park fueled by a culture of innovation,

[251] Art in Every Crevice: The Silent Barn is Back." *The Village Voice*. http://www.villagevoice.com/2013-01-09/art/silent-barn/full.

[252] "Opening a DIY Venue? 'Leases are Much More Confusing Than French Philosophy.'" *Bedford and Bowery*. http://bedfordandbowery.com/2013/08/opening-a-diy-venue-leases-are-much-more-confusing-than-french-philosophy.

entrepreneurship, and increasing sustainability" (Pratt Center for Community Development 2013, xix). In order to understand this move to join the "artisanal/niche manufacturers"[253] there, let us consider the role of manufacturing, artisanship, and zoning in Brooklyn. Although I would not call Death by Audio (as a pedal business) a "factory," in the sense of mass-produced assemblage, it does fall under the heading of the "new" manufacturing that is sweeping across the postindustrial landscape of Brooklyn neighborhoods.

Setting the scene for this transformation is, first of all, Brooklyn's highly fraught relationship to gentrification, or "the displacement of lower status communities by higher status populations" (DeSenna and Shortell 2012, 1). Historian Suleiman Osman (2011) chronicles the invention of "Brownstone Brooklyn"—a socially- and architecturally-defined corridor that, by the early 1950s, stretched across an "industrial belt" bordered by Red Hook in the west and Williamsburg in the (relative) east—and how it became "fertile soil for gentrification":

> First its collection of small manufacturing firms tempered the cataclysmic shocks of deindustrialization after the war. While Brooklyn would see much of its manufacturing disappear after World War II, and would suffer many economic problems of other older urban areas, the process would be gradual and piecemeal. The messy coexistence of the two sectors also blurred the line between industrial and residential space. Factories long sat near the homes of Brooklynites; it was only natural that some Brooklynites in a postindustrial city relished residing near or even within lofts and warehouses. But mostly Brownstone Brooklyn's historic architecture, its diverse antiquated manufacturing sector, its colorful international waterfront culture, and its non-bureaucratic gestalt would in the postwar period capture the imagination of New York's new

[253] The Pratt Center defines "artisanal/niche manufacturers" as "companies that produce either one-of-a-kind or customized products, often with very limited production runs, including manufacturing of sets and custom installations for the entertainment industry and fine-art pieces" (2013, x). These account for 45% of tenants at the navy yard and have been increasing since 2000 (ibid., xi).

> bureaucratic white-collar labor force. Along with the brownstones and mom-and-pop shops of its residential area, *Brooklyn's non-Fordist industrial and commercial landscape formed the template for a new post-Fordist middle-class romantic urbanism*. (34; emphasis mine)

Waves of gentrification ebbed and flowed throughout the twentieth century, based first on ethnicity and, later, race, in cycles conceived of as degradation and "urban renewal"; in the 1960s-70s, especially, college-educated "bohemians" embraced the "nostalgic" senses of neighborhood, attracted by the implied grandeur of brownstone buildings and sometimes embellished social histories of their surroundings. And since the 1950s Beat generation, so-called hipsters have flocked to the peripheries of these neighborhoods in search of Brooklyn's "untamed authenticity," a "rawer form of urban verité" (107), but "unintentionally reshaped the landscape they saw as authentic" (108).[254] Such patterns continued in the early twenty-first century, as Brooklyn remapped itself as a center for arts and industry (eventually, in the case of underground music, recasting Manhattan as a relative periphery). These patterns became greatly exacerbated in particularly arts-centric neighborhoods like Williamsburg, the demographics of which changed from predominantly working-class Polish (on the northside) and Hispanic/Jewish (on the southside) to young, white, college-educated artists and, most recently, wealthy young professionals relocating from Manhattan. Efforts to open community dialog, especially by artists, have been met with mixed results by residents, as part of "processes of exclusion and inclusion that go on throughout the neighborhood as it gets branded as a site for luxury" (Martucci 2012, 110).

[254] Osman draws on Norman Mailer's 1959 "The White Negro: Superficial Reflections on the Hipster": "the bohemian and the juvenile delinquent came face-to-face with the Negro, and the hipster was a fact in American life" (cited in 2011, 107).

For its part, Death by Audio's community, discreetly situated in a warehouse on the outskirts, was clearly not inclusive for many local residents. Demographically, members were mostly (but not entirely) white, in their late twenties through mid-thirties (by 2015), and college-educated but financially precarious; audience members at performances were slightly more varied.[255] Although not displacing existing residents (by moving into non-residential space), their impact would have added the kind the cultural value to the neighborhood that collectively breeds gentrification. Members were sensitive to this dynamic—both out of self-preservation and community preservation—hence a further impetus to remain as unobtrusive as possible. But although Williamsburg and Greenpoint were largely white working-class neighborhoods prior to gentrification, the artist migration to other neighborhoods has different historical entanglements. Now that Death by Audio's pedal workshop has moved to the Navy Yard area (and its house bands to practice studios nearby), they are encroaching on a historically important African-American musical community, the hip-hop scene associated with Clinton Hill, Fort Greene, and Bedford-Stuyvesant (Adler 2013). The outcome of such collective moves in terms of residential patterns and job creation remain to be seen, but as I show below, trends in artisanal manufacturing in and around the Navy Yard offer a glimpse into the immediate future.

Another factor in this transformation is the role of city zoning policies. In the

[255] I believe other demographics would have been welcomed, but they were not explicitly sought, under the assumption that listeners/participants were a self-selected crowd. On the venue's last night, they made a guest list to ensure that long-time friends were allowed entry, as the large crowd waiting was many times the expected size. Outside, the conversations I heard from other potential audience members centered on either the exclusivity and unfairness of this door policy ("But I came all the way here and waited just like everyone else."), or, conversely, complaints of inclusivity ("I've never seen any of these other people here before.").

Department of City Planning's words, "zoning determines the size and use of building, where they are located and, in large measure, the density of the city's diverse neighborhoods."[256] In essence, it creates "a blueprint for the entire city."[257] The northern Brooklyn neighborhoods of Williamsburg and Greenpoint were rezoned 2005, changing much of what had been industrial space into residential space. These waterfront locations once facilitated the transportation of goods and made them attractive sites for large industrial complexes; however, industry (and the jobs it created) had been declining over the past decade, and by the early 2000s, the time seemed right to update the prior zoning ordinance, which dated from 1961.[258] The *New York Times* noted city plans to "capitalize on one of New York's ignored assets" and "move aggressively to spruce up its aging waterfronts," citing Mayor Michael Bloomberg as calling these areas "priceless but long derelict" and then-current industrial uses as "inappropriate" (Cardwell 2005). Such analyses disregarded the Brooklyn waterfront's "off-record" relationship to artists and musicians, who benefitted from the vacant, decaying sites through cheaper rent for apartments or workspaces (sometimes illegally or quasi-legally) and fewer noise restrictions. The "inappropriate" uses referred to "power plants, waste transfer stations and porn shops" (ibid.) but could presumably be extended to artists' uses, as well. As a result, the waterfront transformed, leading to a boom in high-rise luxury condo

[256] http://www.nyc.gov/html/dcp/html/zone/zonehis.shtml

[257] http://www.nyc.gov/html/dcp/html/zone/zoning_today.shtml

[258] In the period from 2000-2013, New York lost 100,000 manufacturing jobs, many of which were middle-wage jobs; in contrast, the highest source of new job growth was in the low-wage service sector. Similar dynamics have also affected the Gowanus neighborhood in recent years.

construction and commercial services that catered to this new resident demographic.[259]

Rezoning "created a wave of real estate speculation," explains urban planner and historian Inna Guzenfeld.[260] Industrial buildings earn less money per square foot than residential development, so "properties were deliberately kept vacant by their owners" and developers bought up vacant warehouses until they figured out if and when it would be cost effective to repurpose them. For instance, in 2002, the iconic Domino Sugar Factory (down the street from Death by Audio) had a series of labor disputes and closed in 2004; in 2014, a finally redevelopment process began to turn the site of the "the last large-scale factory work in Brooklyn" into a "35-story residential and commercial 'megaproject'" (Raiford and Hayes 2014).[261]

In the interim, some of these buildings rented space to artists and other "creative

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[259] At the time, some optimistic politicians and community leaders praised the rezoning regulations as including measures for what they thought would be a scourge of affordable housing in addition to high-income residences (Cardwell 2005). In my estimation, any increases in affordable housing have been negligible and have not improved the lives of any of my interlocutors (none of whom work or live in Williamsburg any longer). The Navy Yard's waiting list for new tenants as of 2013 was likely due to business being "priced out of other areas. More than 20 firms on the waiting list noted current addresses in Williamsburg, Long Island City, and Bushwick—three neighborhoods experiencing mounting pressure for conversion to residential uses" (Pratt Center 2013, 27). Grooms has also referenced the condo conversion in their 2015 song "Something Wild," about "destroying the high-priced waterfront condos that contribute to the rising cost of living in neighborhoods like Williamsburg and Greenpoint, and then feeling conflicted about it" (according to their album's press release: http://westernvinyl.com/shop/wv127.php), accompanied by detached vocals and icy keyboards swells.

[260] Guzenfeld's comments are from a lecture entitled "Made in NYC: The Reinvention of Local Manufacturing" delivered at Brooklyn Brainery on February 25, 2015. Brooklyn Brainery is a venue in Prospect Heights that offers inexpensive talks and classes in a small, social community setting, sometimes including topics in music and electronics.

[261] For more context on the labor history of the Domino Sugar Factory, see Raiford and Hayes 2014.

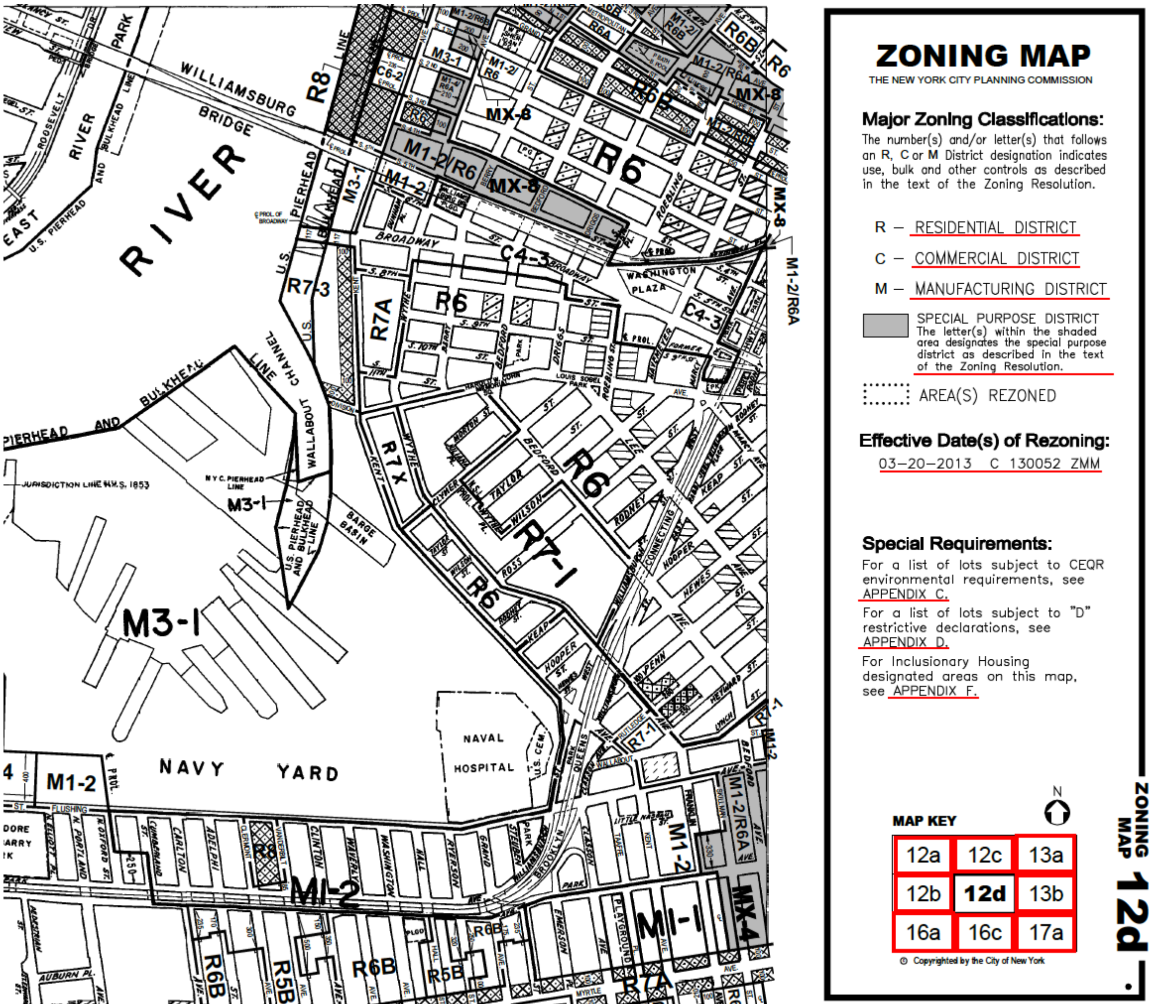

Figure 57. Excerpt from the Williamsburg zoning map.[262]
Death by Audio was on the "manufacturing district" block labeled M3-1 and has recently moved to the M1-2 section. The label R8 covers the grounds of the newly residential Domino Sugar Factory site; a view to the north would show a long, narrow strip of residential plots along the waterfront curving up through Greenpoint. The Brooklyn Navy Yard is at bottom.

sector" small businesses. Following the 2008 economic recession, development plans stalled, and many landlords were left with underused space. (Even construction that had started prior to the recession, including one across the street from Death by Audio, sat

262 From the New York City Planning Commission: http://www.nyc.gov/html/dcp/pdf/zone/map12d.pdf

unfinished for years.) When Death by Audio referenced the positive relationship with their landlord, they meant that they were allowed to do mostly as they pleased while paying a reasonable rent, knowing that a time might come when the temptation to find more lucrative tenants prevailed. Businesses have even arisen to connect artists with such spaces: the Greenpoint Manufacturing and Design Center, for instance, is a non-profit industrial developer that has "rehabilitated six North Brooklyn manufacturing buildings for occupancy by small manufacturing enterprises, artisans and artists."[263]

A recent survey conducted by the Pratt Institute found 2,000-3,000 industrial jobs that one might not think to categorize as "industrial" because they involve artistic endeavors such as woodworking.[264] The "big industrial behemoths…have found locations where wages, taxes and real estate costs are lower, traffic is not as snarled, regulations are not as burdensome, and there is elbow room for the scale required by modern machinery and trailer trucks. Their departures have cost the city thousands of jobs nearly every year for decades," writes journalist Joseph Berger (2012), but "Brooklyn is increasingly retaining some of its remaining industrial spaces for small-scale, small-batch manufacturing." The mitigating factor in this positive uptick is that these "niche enterprises" employ substantially fewer people than the behemoths—a problem for "Maker" businesses of all kinds. Due to a number of logistical issues—the internet filling

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[263] See http://www.gmdconline.org/about-us. The GMDC is outlined in Pratt Center 2013 (22), which calls it "critical" for the well-being of artists but "threatened" due to creeping gentrification: "While this financing strategy is similar to that of BNYDC [Brooklyn Navy Yard], unlike BNYDC, GMDC operates in neighborhoods with privately owned land threatened by gentrification. As a result, it is often challenged by the impact of real estate speculation and inflated land acquisition costs that often make the acquisition of a project financially infeasible."

[264] Manufacturing is considered a subset of industrial jobs: http://www.nyc.gov/html/imb/downloads/pdf/whitepaper.pdf

roles once filled by people, the small quantities produced when catering to niche markets—Kay S. Hymowitz argues that "these boutique businesses have a limited impact on the borough's total economy. For all their energy and creativity, Brooklyn's young entrepreneurs tend to have few employees, and they're not likely to be hiring large numbers in the future" (2011). Even arts entrepreneurs using online marketplaces (the most famous being Etsy) to sell handmade goods have found their capacities for growth inhibited: "The artisans have run head-on into the problem that led to the Industrial Revolution: Making things by hand is slow. Really slow" (Barber 2013). In other words, such business endeavors are not easily "scalable" from small to large companies (Tabuchi 2015).

Nevertheless, "Made in NYC" is a visible movement, and Brooklyn, in particular, has become a brand. Guzenfeld believes that "the media has taken notice because manufacturing is *glamorous*, because manufacturers are Makers." This type of DIY manufacturing appeals especially to young New Yorkers who are tired of being told that no jobs exist for them. During the recession, she says, there was "something about that economic climate that brought out the entrepreneurial spirit. People want to reconnect with something that's *real*…doing it yourself. [Many times] it's about sourcing things sustainably…about creating an alternative." This self-directed alternative seizes an affinity for tinkering always present for electronics-minded musicians. As Steve Waksman states in his study of tinkering with electric guitar equipment (and David Novak later found among noise musicians), this practice is "a mode of self-directed activity in which musicians have sought to carve out a sphere of 'independence' from the broader structures that govern the music and guitar-manufacturing industries" (Waksman

2004, 676-677). The Maker Movement and the new artisans of manufacturing may be the glitzier darlings of the millennial media, but the traditional tinkering spirit is likewise alive and well at Death by Audio, which traverses all of these domains to become emblematic of today's DIY businesses in Brooklyn.

Conclusion

For DIY music technologists, the process of building a guitar effects pedal comprises nostalgia, adaptation/modification, and experimentation—a current flowing through a circuit of prototypes—and the symbolic power that pedals have held every day at Death by Audio is immense, influencing sounds, knowledge, space, and behavior. We saw in this chapter how various kinds of blueprints act as (re)configurable plans that structure relationships between humans as well as things, with the guitar pedal at the center of this web. Let us also linger again for a moment on technoaesthetics, which emerge as realms of sensory experience through which builders come to understand machines. Technoaesthetics are "everyday modes of interacting with…technologies, forms of perception, and practice that unify divergent groups…" (Masco 2006: 44). They also reflect "the evaluative aesthetic categories embedded in the expert practices" of a given group, "largely determine the politics of the enterprise within the epistemic cultures" of the workshop, and constitute and express both meaning and pleasure (ibid.). Death by Audio's everyday aesthetic experiences with technology produces an entanglement of guitar pedals, noisy rock bands, an ethic of self-sufficiency, and a community that valued such things. Together, blueprints and technoaesthetics build on other existing infrastructures to flexibly, adaptably structure further interactions between people and things (such as pedals, circuits, schematics, and the built environment).

Death by Audio, in its next phase, remains a work in progress—a blueprint in progress—for a DIY music technology enterprise nested in an underground music scene. For my interlocutors, the meanings and pleasures of their activities are located in their contributions as cultural citizens: they address a perceived lack of sonic risk-taking in present-day New York, a lack of community for fostering less-than-popular bands, a lack of high-quality sound equipment that appeals to their aesthetic tastes, and a lack of employment opportunities for local musicians. In offering homegrown solutions for these shortfalls, they offer a prototype for DIY citizenship in the changing landscape and soundscape of twenty-first-century New York.

Conclusion:
Opening Dark Circuits

June 2014, Chelsea, New York

The venue Eyebeam is closing. Temporarily, that is, until it relocates far out into Brooklyn. But for now this cavernous space housing an art and technology center on the edge of Manhattan is sparsely furnished. Audience members set up their own folding chairs for tonight's performance; tomorrow there will only be picnic blankets left. I am here for the Dark Circuits festival, the brainchild of German native Hans Tammen, with whom I have performed in a circuit bending orchestra (see chapter 3) and seen host events at the educational music technology center Harvestworks nearby. It is billed as a festival for "contemporary electronic music practices such as circuit bending, no-input mixers, laptops, turntablism, analogue circuitry, network sniffers, live coding and soldering, plus other instruments we may have never heard of yet."

First up, all of the festival performers improvise at once with 20 synthesizer sets made up of littleBits, the modular, Lego-like educational toy (from chapter 1) that has exploded in popularity among Makers over the past year. Tammen strikes me as more of the traditional avant-garde electronic music type, so I am a bit surprised to see the product of a youth-savvy start-up company pursuing an ubiquitous advertising campaign (as of late, on Facebook and in numerous New York subway stations) present at this event. Moreover, the company had formed a "littleBits quartet" comprised of their own engineers to perform at the tiny loft space Spectrum for an earlier part of the festival. Then again, distinctions between experimental music scenes are frequently messy. As it turns out, tonight's goal of creating a "monster synth" from the modules might be better in theory than in practice. An amorphous drone of bleeps, blips, and whirs seems to drag on unenthusiastically—too many tools operated by too many cooks in the kitchen, it seems.

For the second act, each performer showcases an instrument of his or her own making, as Tammen conducts them in his open form multi-movement piece Apheresis*. "Modules" take on a different meaning here, in that Tammen is inspired by American experimental composer Earle Brown's (and perhaps others') use of modular sections within a work that can be mixed and matched at will. The ensemble features many people I have encountered over the past few years, not least of all are New York's Phillip Stearns and Berlin/Mexico City's Mario de Vega, both of whom first entered my fieldwork notebook the same day in 2009. Other notable participants include Peruvian "abstract turntablist" Maria Chavez, jack-of-all-feedback-trades Philip White (I scan my memory for the last Brooklyn DIY venue at which I might have heard him), improvisational musician of electronics and extended techniques Andrea Parkins (my first encounter with her performance), and veteran German DIY circuit-builder Joker Nies, among a handful of others. In Tammen's work, all performers have a chance to emphasize the unique qualities of their instruments, as he holds up a sheet of paper directing them to "SOLO" amidst instructions to produce collective volume swells, low pitches, or silence.*

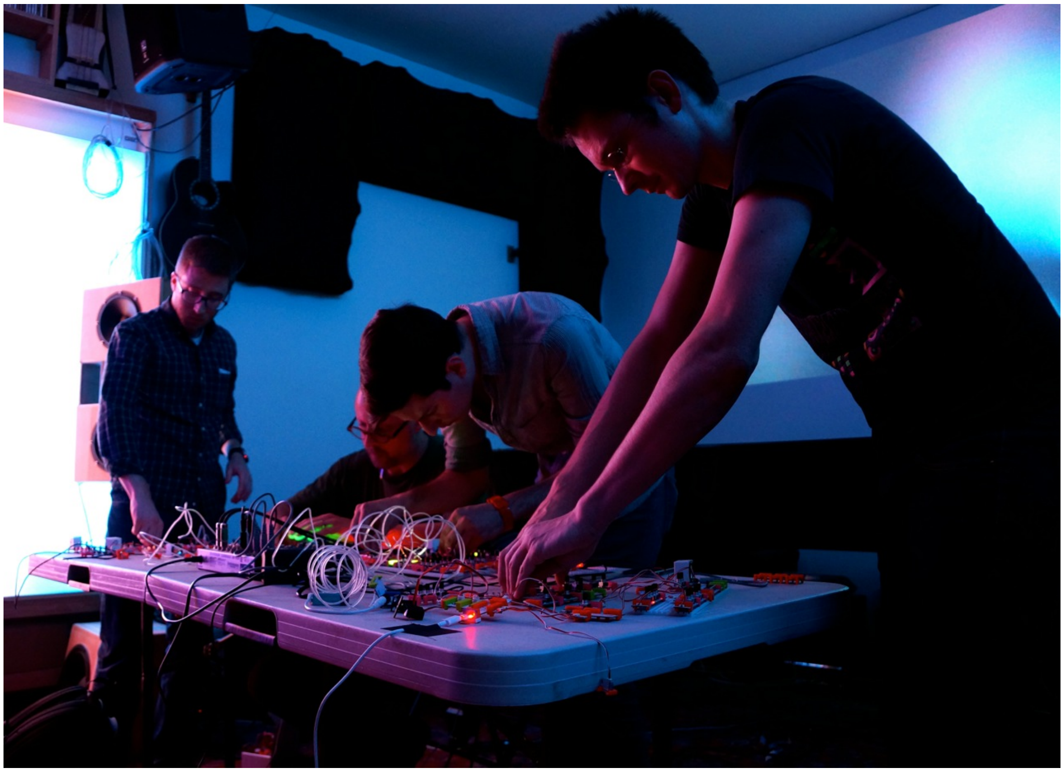

Figure 58. littleBits employees perform music as a quartet,
Dark Circuits Festival, Spectrum, June 2014

As I conclude this dissertation, let us consider the meaning of "dark circuits." At that festival, the phrase referred to experimental, scarcely known, underground practices of using electronics to create sound. For me, it also conjures the concept of "black boxes," technological objects in which the inner workings are obscured, leaving only inputs and outputs. It implies that most people are left "in the dark" and missing out on a valuable experience by not participating in building, listening to, and understanding these sonic circuits.

Through these "sonic black boxes," myriad ways exist in which circuits can conceal or reveal audible information. Public interest in opening the black boxes of musical instruments and their extensions might, to cynics, seem relatively benign or even trivial, but as I have argued throughout these chapters, DIY music technology is part and parcel of a world of experience intertwined with our everyday lives, in realms of both the mundane and the extraordinary. In future research, I hope to extend the notion of "instruments" even further afield to consider what is at stake in opening "sound-producing objects" and the impact that darkened (as in obscured) flows of information can have on our consciences.

For example, consider Teufelsberg, or "Devil's Hill" in German, which I stumbled upon while conducting my fieldwork in Berlin. (More specifically, I had heard of it from a co-founder of NK Projekt and soon after came upon it while hiking.) Now the city's highest hilltop, it began not as a hill at all, but as an immense pile of WWII rubble, collected and heaped atop of the remains of a Nazi military training school that was found too sturdy to destroy.[265] Its location in the middle of the city's Grunewald forest (a protected area since the time of the Prussian state) landed it in the British sector of postwar-divided West Berlin, where it became a spy station, or "listening station" for intercepting radio signals, jointly run by the British and the U.S. National Security Agency. State-of-the art audio equipment was hidden and protected by fiberglass domes. After German reunification, it became privately owned by developers who had ambitious plans for exclusive apartments, hotels, and a spy museum. But these plans never took off, and eventually the site was abandoned. Now a decaying relic of the Cold War, Teufelsberg attracts mainly adventurous tourists and New Age gurus; for instance, eccentric director David Lynch once failed to build an "invincible" meditation university on the site; after his even more eccentric meditation guru spouted language about creating

[265] Official publications about Teufelsberg are rare, but information is collected online among enthusiasts and former workers at the site. For instance, the Chaos Computer Club, one of Berlin's (and the world's) first hackerspaces, hosts this one: http://dasalte.ccc.de/teufelsberg/index.html.

Figure 59. Beneath, yet blocked from entering, one of Teufelsberg's towers, in Berlin's Grunewald, May 2013

an "invincible Germany," the public quickly cooled to this plan.[266] Tourists come due to the site's otherworldly aura: a few years ago, Teufelsberg only attracted graffiti-spraying locals; now, word has spread about the artificial mountain containing the remains of two human diplomatic catastrophes, looking like an abandoned spacecraft, in the middle of an

[266] From the newspaper *Der Spiegel*'s site *Spiegel International Online*: www.spiegel.de/international/zeitgeist/director-buys-berlin-mountain-david-gets-lynched-over-invincible-germany-meditation-center-plan-a-517873.html

Old World forest, complete with roaming wild boar. People want to physically experience the site's presence and wonder what secrets it held—what equipment was used, what did people hear? The allure is mystical as well as scientific. Architectural acoustics specialist Trevor Cox visited the site and found the spherical domes to cause a disorienting listening experience; his newly published book on the science behind "sonic wonders of the world" (2015) attempts to decode this experience for the public.

Since 2011, visiting Teufelsberg has been legal, but it has also been a confusing experience, with private guards hired to patrol the hill and demanding compensation for so-called "tours" that were unlikely to be very informative. (Personally, I was able to hike around the borders of the compound but was fiercely reprimanded in German when trying to enter.) A 2013 initiative to preserve the site and provide better visitor information is underway; at least one former military employee now gives tours emphasizing his experience there as a former technician. Although even *his* understanding is partial: "In intelligence work, the basic rule is you only get the information you need to do your work—not anything else."[267] As of 2015, they have a new website offering tours that include a "sound experience tour" of the tower domes.[268] Thus, the black box—the inner workings of the entire building complex, in this case—finally appears ready for revelation. If, that is, anyone is truly equipped to divulge such details. Teufelsberg capitalizes on the memory politics of Berlin's troubled twentieth century; people visit this abandoned "listening station" in order to relive the history of spies and warfare—from a safe distance—and to comprehend the toll it took on Berliners

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[267] Quote from an article by Nadja Sayej (2013): http://motherboard.vice.com/blog/take-a-tour-of-teufelsberg-berlins-abandoned-nsa-listening-station.

[268] http://berliner-teufelsberg.com/web

past. In essence, they visit in order to reorient their intellectual and sensory experiences of the city.

Sonic black boxes come in many forms, but their resulting sounds—or the imagined potential for these sounds—constitute an aural enchantment that captures the public imagination. If we are to consider *acoustemology*, as Steven Feld put it, "one's sonic way of knowing and being in the world" (Feld and Brenneis 2004, 462), then my interlocutors' worldviews are dually framed by enchantment and cultivation. Participating in DIY music technology means opening sonic black boxes, which in turn propels participants to navigate wild new routes of sound, self, knowledge, and citizenship. Ultimately, this transformational process of *becoming* (re)orients one's way of knowing and being in the world.

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